MAY 12 1925
Engineering Library

Founded 1874—Fifty-One Years of Service

Electrical World

McGraw-Hill Company, Inc. *May 9, 1925* Twenty-five Cents Per Copy

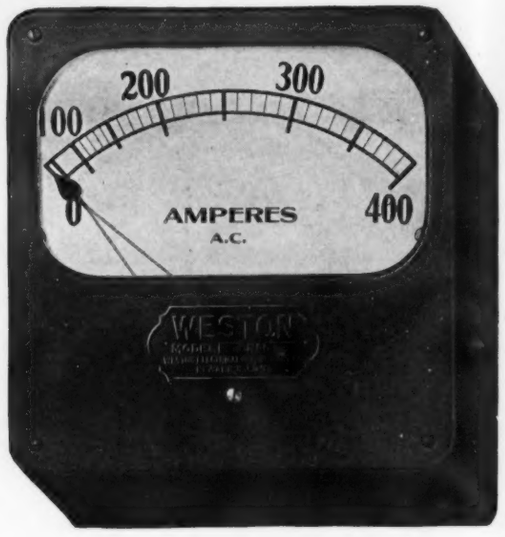
From the Early Period
of the Telegraph to the present
remarkable development in the field of Electricity

KERITE

has been continuously demonstrating the
fact that it is the most reliable and
permanent insulation known

KERITE INSULATED WIRE & CABLE COMPANY
NEW YORK CHICAGO
DAYS KERITE

One of the many new great Central Stations now under construction using Weston Rectangular Instruments.



Specifications call for fewer panels and

WESTON
RECTANGULAR INSTRUMENTS

Leading engineers are trying to increase capacity without incurring too great a capital expense. And they are doing it. The great stations that are now being planned and constructed will be the proof.

In this up-building of the Nation's electrical facilities, Weston Rectangular Switchboard instruments are playing an important part.

It is on the basis of minimum space requirements, medium first cost and practically negligible maintenance cost that these new Weston instruments are being chosen. In every respect they are unsurpassed by any other instrument made here or abroad.

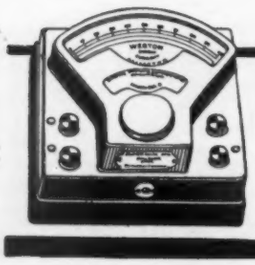
The great visibility of the scales of these rectangular instruments is a decided advantage to the operating engineer. He can readily read them from a distance because of the wide open scales with their bold types of arcs and figures.

These splendid instruments mounted in a new case, have all the excellence of the well known Weston round pattern type used for over a quarter of a century with complete satisfaction.

Weston rectangular instruments have gained instant recognition. Their size, 5¾ in. wide, 6 in. high, 4¼ in. deep, is one that has received commendation everywhere.

Our new booklet 1504 especially prepared for you gives full details. Write for your copy today.

WESTON ELECTRICAL INSTRUMENT CORP.
13 Weston Ave., NEWARK, N. J.
Branch Offices in All Principal Cities



STANDARD THE WORLD OVER
WESTON
Pioneers since 1888

Electrical World

THE CONSOLIDATION OF ELECTRICAL WORLD, ELECTRICAL ENGINEER AND AMERICAN ELECTRICIAN

Published by McGraw-Hill Company, Inc.

W. H. ONKEN, JR.

Editor

VOLUME 85 — *New York, Saturday, May 9, 1925* — NUMBER 19

Death of Milan R. Bump

THE sudden death of Milan R. Bump in Denver this week comes as a shock to the electric light and power industry and to the firm of Henry L. Doherty & Company, with which he was connected. Still in the prime of life and busily engaged on important engineering projects, his death seems all the more calamitous. He, of all the men who have been president of the National Electric Light Association in recent years, typified most distinctively the engineer. His training, experience and life work were along engineering lines, and it was on the technical committees of the association that Mr. Bump's counsel and guidance were most effective. Large of stature and tender of heart, Mr. Bump betrayed all the reticence and shyness which go with scientific training. Realizing, as men so trained must, the smallness of men collectively and individually when compared with the world on which they dwell—itself an atom in the universe—and with the vast forces of nature, he was free from egotism or self-assertion. An accomplished engineer, he rendered faithful and untiring service to the electrical industry, but always as a man among other men, never with an assumption of superiority because of his native ability and his acquired knowledge.

Man cannot linger forever on the earth, yet, while the scythe of time eventually cuts us all down, there are those whose departure seems to leave a gap in human affairs not to be filled at once, and Milan R. Bump was one of them. His associates and friends and the industry he so faithfully served will long mourn him.

The American Society for Testing Materials

IN THE minds of many the American Society for Testing Materials is associated with specifications for steel and cement. It is not realized that its four hundred standards and tentative standards, including specifications and methods of testing, cover a much wider range of materials. Nor is it appreciated that much of this work is of direct value to the electrical industry, which employs in engineering and construction work so many materials other than electrical ones.

Two of the forty technical committees from which the principal results of the society's activities emanate deal with materials which are strictly electrical, namely, copper wire and insulating materials. The committee on rubber products includes materials used exclusively in the electrical industry, such as tape, wire and cable, rubber matting and rubber gloves for electrical workers; but the committee on electrical insulating materials should prove to be rendering the greatest service to the electrical industry because it is dealing with materials upon which the successful performance of all electrical apparatus depends. It is as yet confining its attention to developing standard methods of testing such materials, for such standardization is not only necessary before purchase specifications can be developed, but standardization is essential to the most efficient investigation of new materials and, therefore, to the most rapid advancement of the art. And as any one will appreciate who has had anything to do with the testing of insulating materials, the need is very great for standardization among the many combinations and permutations of testing conditions that can be employed.

The committee has issued nine methods of testing, many of which have been through several revisions. In addition, its annual reports contain much material resulting from the investigations which many of its forty members are carrying on more or less continuously, as well as general information, such as the timely discussions of the dielectric strength of insulating materials and their dielectric losses which appeared in appendices to the last annual report. The committee is doing pioneer work, producers, consumers and public utilities freely contributing through its instrumentality to the common cause of the advancement of the electrical art.

System Standardization and Efficiency Are Apparent

THE light and power industry never ceases growing, and the statistics in this issue showing 21,932,996 kva. in generators installed afford more evidence of this truth. In eighteen months this aggregate rating has increased 22.6 per cent, and the percentage shows the significance of the great station-building program recently inaugurated by the industry. But, in addition to the rate of growth, there are other very notable trends made evident by the statistics. Operating efficiency has increased through interconnection to such a degree that less than one per cent of the generating capacity is listed as reserve equipment. Thus the industry has produced reliable equipment and eliminated costs associated with carrying reserve generators.

Another trend is the decrease in direct-current capacity in proportion to the alternating-current generators. At present less than one and one-half per cent of the generator capacity is direct-current, and this fact again speaks well for the builders of the industry. Interconnection of systems and economic transmission depend on alternating-current generation, and the industry is ready to take full advantage of all opportunities in these directions at a minimum cost. Standardization in frequency is well under way also, and only a few scattered systems operate at frequencies which handicap the full economic development of interconnection. The three-phase, 60-cycle system has become a standard development for utility companies, and the few 25-cycle systems and two-phase, 60-cycle systems exist because of local conditions which future developments may modify in such a way as to bring about a standard system.

The purchase of all their energy by 1,858 utility companies shows a great trend toward local distribution and wholesale generation and transmission. Economy in production and transmission call for big systems and waste is eliminated. But in handling local service and developing local public relations retail utility properties find a good field of operation. They purchase energy under best conditions and distribute it with an intimate knowledge of customer requirements. The statistics show that the light and power industry is taking full advantage of every opportunity to bring about standardization and simplification in its operations, and even now there is little if any waste apparent in any phase of its activity. Intelligent leadership, based on facts and foresight, is bringing very positive results.

Better Industrial Heating Data Are Needed

IT IS hardly surprising that so rapidly growing and useful an art as industrial electric heating should be handicapped in these earlier days of development by inadequate data. Wherever specialists in this field foregather this lack is voiced. Descriptions of installations are plentiful and complete enough, and these serve a necessary purpose in exchanging reports on practices and showing prospective customers physical realities, but the "before and after" economic data so urgently desired by both manufacturers and central-station companies are pitifully scarce. We believe that the situation will improve from now on, but progress will indeed be slow unless heating problems are attacked with true scientific thoroughness by engineers responsible for the success of equipment design and applications.

Electric heating engineers are not responsible for past failures of prospective customers to keep reliable cost records of process fuel costs prior to the advent of electrical methods, and yet some fair degree of accuracy in estimating these must be attained if the economic justification of the electrical installation is to be "followed through." Far too little is known about the cost of handling fuel oil from tank car to burner (this averages 1.5 cents per gallon in one large company with many plants in the East), about the quantities of fuel used in specific processes, about the accurate labor content and maintenance expenses of individual manufacturing and treating operations under many conditions, about the prorated overhead costs of operations and apparatus which the electric heating engineer plans to supersede or improve, and about the cost of spoilage or of damaged work under conditions of poor control frequently associated with non-electrical methods. Often the prospective customer's idea as to such costs represents the merest guesswork, and the absence of reliable instrumentation complicates the difficulty of getting at prior costs, especially in processes using gas, oil or coal intermittently and on irregular time cycles.

Permission to install suitable measuring devices should be sought wherever feasible before the older installation is abandoned in favor of electricity, and here is a great field for the co-ordination of resources among power and heating engineers. It is quite as important to obtain heating data from such installations before changing over as to indicate reciprocating engines and study heat balances in analyzing plants for possible motor driving. It goes without saying that adequate records of time cycles, production volume, energy consumptions, etc., should follow the application of industrial electric heating so far as practicable. Through the interchange of more complete data the whole art will advance more surely and more rapidly, customers will be better served, and sounder progress will be guaranteed.

Utilitarian Wall Brackets Are Much Needed in the Home

AN ANALYSIS of the present conditions and requirements of residence lighting reveals a crying need for more wall brackets in the home. Of course, there are various ways of equipping the different rooms for utilitarian lighting. In some cases portable lamps of proper design may do the work of brackets on the walls or attached to mirrors. However, an average of eight brackets is required for utilitarian lighting. This allows one over the kitchen sink and one at each side of the mirror in the bathroom and in each of the bedrooms, averaging the bedrooms at two and a half per family. Instead of this total of eight such wall brackets in the average home, however, there are only two and a half per home. If wattage of lamps is considered, it is found that the connected load in utilitarian wall brackets should be increased to four times its present value.

The satisfaction derived from lighting by means of wall brackets over kitchen sinks and at mirrors is easily demonstrated. In fact, its desirability is generally accepted by experts. Ceiling fixtures may provide satisfactory lighting for the room as a whole, but they must be supplemented by equipment at the mirrors and workplaces near the wall. Until recently residential lighting requirements were not analyzed, and without such analysis the necessity for wall brackets or other equipment providing similar lighting was not apparent. There is no longer any excuse for neglecting this type of installation. Of course, besides the eight utilitarian brackets specified, there are opportunities in the home for others of primarily decorative purpose.

Co-operative Tests on Oil Breakers

ADEQUATE protection of large electrical systems must be secured if reliable service is to be rendered, and the oil circuit breaker is the main reliance for interrupting circuits in trouble. At best the oil breaker is subjected to a big task, but it is essential that its limitations be known so that systems may be designed with an understanding of permissible energy concentrations to faults.

Manufacturers of oil breakers and utility engineers are faced with the problem of developing the best possible oil breakers, and it is fitting they should co-operate fully in solving the problem. The tests made by the American Gas & Electric Company and described in this issue show that co-operative tests make possible the use of actual system capacities for breaker tests which give data of great value. Similar tests at lower voltages have been made on other properties using American breakers, and it is encouraging and helpful to have the test results made available to all interested in system protection and operation.

The high-voltage tests described are of great interest because of the voltage used, the capacities interrupted and the type of breaker tested. Multiple-break oil

breakers have been used for several years in Europe and by one or two utilities in this country, but many American engineers have questioned their value. The tests show that the multiple-break type of equipment can handle large-capacity circuits at high voltage very successfully even though several cycles elapse before the circuit is interrupted. The time element required must be considered carefully in relay settings, and it would be interesting to know the variation in time required to interrupt a circuit of given capacity for several identical operations using a multiple-break type of oil breaker.

Another interesting feature of the tests is associated with the large number of "shots" each breaker handled successfully. Engineers and breaker designers have long debated the number of operating cycles a breaker should be expected to perform successfully, and the data obtained in the tests should be very helpful in reaching a decision. There is much to be done in determining whether breakers can be made to handle two or three million kilovolt-amperes successfully, and cooperative tests of the kind described in this issue furnish data and stimulation for the competitive development essential to the progress of the industry.

Radioactivity of State Executives

A POWERFUL weapon has been put into the hands of state governors who have hostile legislatures on their hands by the continued and increasing popularity of the radio. Previously the executives could appeal in two ways from the legislatures to the people from whom both derive their powers. They could publish their views in the public press or they could announce them from the public platform. From the governors' standpoint both ways were faulty. Few voters take the trouble to read long political statements and few attend political meetings. Moreover, hostile journals could ignore, unduly condense or garble the printed word, and the largest auditoriums hold only a fraction of the electorate in but one out of many political subdivisions.

The astute Governor of New York showed the way out. Nearly every one will listen to the voice of a prominent man when he or she can do so in an easy chair at home. It is almost like a personal appeal from the seats of the mighty, and the speaker must be destitute of any power to interest or persuade if he cannot hold his audience, covering the whole state and numbering a hundred persons for every one who would journey to a public hall to hear him. No one can blame the governors for thus grasping the weapon that modern discovery and invention have put before them. Yet the method contains possibilities of great abuse. For how many of the hearers would "tune in" on the following or any other evening to hear the rebuttal of those who may be attacked—not great political luminaries in executive chairs, but humble assemblymen and state senators, despised political bosses, or it may be mere utility men engaged in the production of light and power or some other universally desired commodity and pictured by too many of those they serve as greedy and grasping monopolists selling their product at enormous profits to a long-suffering community?

We submit, therefore, that when governors do as the Governor of Ohio recently did—aim their wave-metered but otherwise unmeasured censure not only at political opponents but at private citizens whom they accuse by name of unwarranted political interference—they are taking an unfair advantage, much like that taken by the bulldozing judge to whom the alleged culprit before him is unable to "talk back."

Loaded Transatlantic Cables

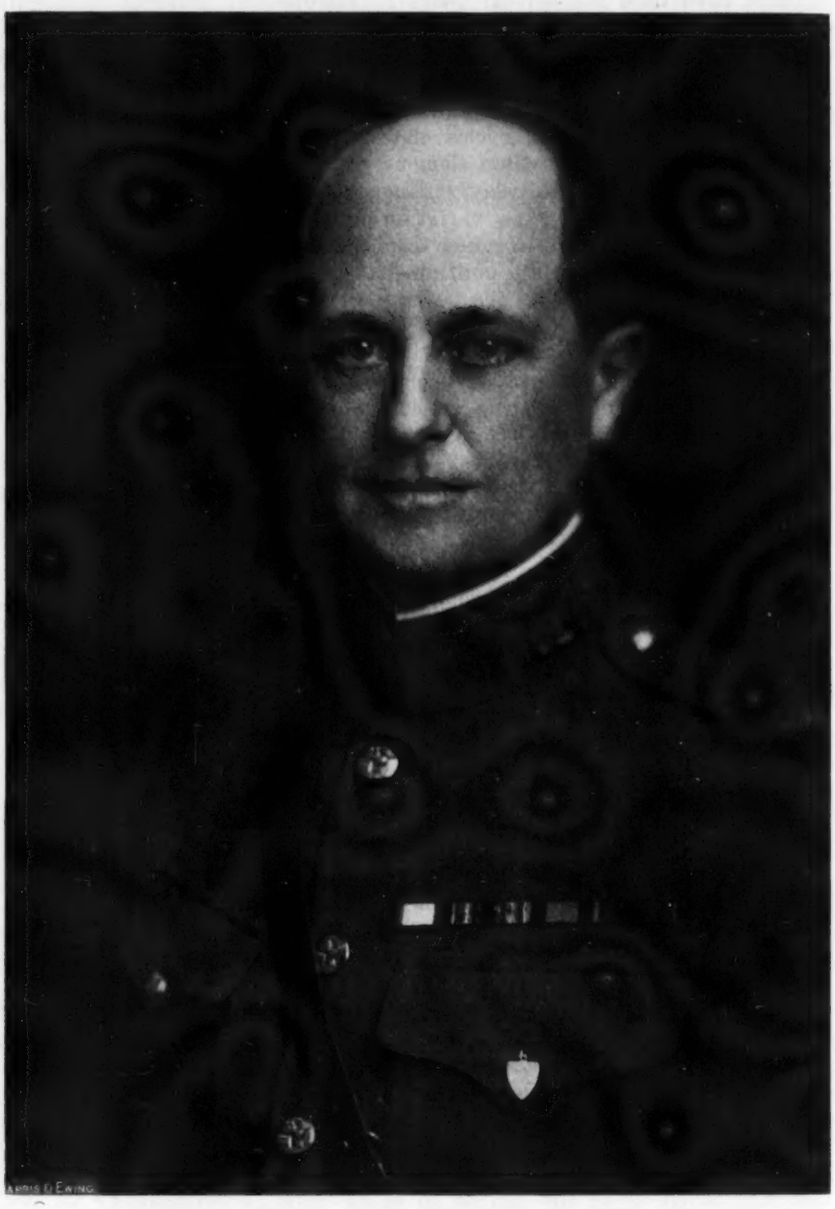
THE disturbing effects of inductance and capacity in all types of electric circuit, when either is present in excess, and their mutually corrective properties have long been known. The form of the application of the corrective principle varies widely. Static condensers correct low local power factors, synchronous apparatus the power factors of large stations, and on long power lines synchronous condensers stabilize load regulation. These principles were recognized first in connection with telegraphy, that first application of electrical science to the use and comfort of man, but their utilization has been very slow in that field as compared with others. Heaviside and Kelvin announced the value of uniform inductance loading for telegraph cables more than thirty years ago; about ten years later Pupin developed the important intermediate step of localized loading coils in long cables, but only recently have we heard that submarine cables may be constructed with a continuous taping of their magnetic material to serve as inductance, distributed as uniformly as the capacity and neutralizing the latter at all points.

This method is almost as old as the principle announced by Heaviside. The so-called Krarup cables are of this type and have been tried in Germany for a number of years with considerable success in telephony but much less in submarine telegraphy. The slow development in this latter field has been due to the want of a material having high inductance and low loss at the very low values of current common in cable telegraphy. The answer appears to have been found in the discovery of the nickel-iron alloys, which have astonishingly high values of initial permeability and other desirable properties. These properties vary widely with the composition and the heat treatment. "Permalloy," as developed by the Western Electric Company, has approximately 78 per cent of nickel and 22 per cent of iron. Its remarkable properties were announced some months ago, and it is known that experimental cables with permalloy loading have been operated and that a transatlantic cable of this type has been laid and has gone into service. Preliminary announcements indicate a greatly improved performance, but complete data are apparently not yet available.

Meantime it is of interest to note from a paper by K. W. Wagner in the *Elektrische Nachrichten-Technik* that the Germans have also made a study of the nickel-iron alloys and have adopted the one containing 47 per cent nickel as best suited for submarine telegraphy. It is claimed that its inductance is more constant over a range of small current values and its resistivity higher than in the case of permalloy, and that in spite of the higher initial permeability of the latter, a more rapid reception and less distortion are obtained with the use of "invariant," as the German alloy is called. These are questions which will soon be answered by further combined experiences and study. At present there appears no doubt that the speed of transatlantic signaling is to be increased from five to ten times and its general character greatly improved.

Colonel William Kelly, U.S.A.

An all-around engineer with an expert knowledge of water-power problems on the rivers of America gained through years of study.



AFTER having served for four and one-half years as chief engineer of the Federal Power Commission, Colonel William Kelly has a knowledge second to none of the whole gamut of the engineering problems which arise in the course of water-power development. As a member of the American section of the Joint Engineering Board on the St. Lawrence River and through his detailed studies of the Colorado River he has been associated with the greatest water-power problems in the country. His previous experience included an engineering study of several of the large rivers of Europe. Colonel Kelly, who is leaving the commission and after a year's rest will become actively identified with the electrical industry, will thus bring with him a particularly broad experience.

Colonel Kelly was born in New York City on January 8, 1877. He attended the public school in Yonkers, N. Y., and high school at Superior, Wis. Before entering West Point in 1895 he had a year at the Sheffield Scientific School. He was graduated from the Military Academy in 1899. He saw service in the Philippines, after which he spent several years on fortification construction. While on a second assignment in the Philippines, he had charge of the construction of the electric railway on Corregidor Island and of a large cold-storage plant. On returning to the United States he served four years as assistant engineer commissioner for the District of Columbia, in which position he had immediate charge of the water and sewerage systems and of the building inspector's and municipal architect's offices.

For four years Colonel Kelly was in charge of the rivers and harbors desk in the office of the Chief of Engineers. On the outbreak of the late war he was made a member of the General Munitions Board of the Council of National Defense. In October, 1917, he was sent to France as chief engineer for the Forty-second Division. After active service at the front for a year he became chief engineer of the Fourth Army Corps. Later he commanded base sections Nos. 7 and 9. After the armistice he was assigned to duty with the American Peace Commission to make a reconnaissance of the five rivers internationalized by the treaty of Versailles. In the course of his military service Colonel Kelly has had various assignments on river and harbor work, including the flood project on the Sacramento River. During his service with the Federal Power Commission he has made a special study of the co-ordination of irrigation and power projects.

Calculations for Transmission Lines

Semi-graphic Practical Method Saves Time and Labor — No Textual Instruction or Handbooks Required — Example Showing Application of Method — Forms Used

By R. C. HORNBERGER
Assistant Engineer United States Bureau of Reclamation

A TRANSMISSION line has resistance, inductance and capacity, but, unlike most other circuits, these properties are distributed over the length of the line and so cannot be handled by the ordinary methods. The exact way of handling them involves hyperbolic functions of vector quantities. These functions have always been considered difficult to apply, and therefore many approximate formulas and methods have been suggested. However, when properly systematized, the exact solution requires a very reasonable expenditure of time and labor—much less, in fact, than is required by any approximate solution of reasonable accuracy with which the writer is familiar. During the last few years several very good tables of hyperbolic functions have been published, making them easy to apply. For this reason the exact solution by means of hyperbolic functions is used. By means of a conversion formula the use of these functions is made no more difficult than an ordinary multiplication by means of logarithms. There is no operation on the forms which cannot be understood by any one familiar with trigonometry and logarithms. The form of the exact solution used is that given by Pernot and others as follows:

$$E_s = \cosh n\theta \times E_r + Z_o \sinh n\theta I_r,$$
$$I_s = \sinh n\theta \times E_r/Z_o + I_r \cosh n\theta,$$

where E_s = supply voltage, E_r = receiver voltage, I_s = supply current, I_r = receiver current, Z_o = surge impedance and $n\theta$ = propagation constant. Z_o and $n\theta$ depend on the physical characteristics of the line. They are computed on form 2 (Fig. 2). The coefficients are replaced by A, B, C and D.

The vector diagram used is the one described by Mr. Holladay[1] with certain modifications. Mr. Evans and Mr. Sels, in their work on the circle diagram[2], have pointed out that the losses in the line can be represented as a set of concentric circles. These loss circles have been added to the diagram so that the line losses can be determined directly for any load.

The first sheet (Fig. 1) is merely a tabulation of the predetermined and assumed data, including the physical characteristics of the line. The size of the wire for which the computations are to be carried out can be roughly determined in several ways. It can be arrived at by one of the various approximate formulas which take into account only the resistance or resistance and reactance drop of the line[3] or it can be obtained from an estimating table[4].

The second sheet (Fig. 2) contains the constants of the line, which depend on the physical properties, size and spacing of the wire, and the computations to find the two fundamental constants of the line—$n\theta$, which is known as the propagation constant, and Z_o, known as the surge impedance of the line.

The resistance can be found from a wire table, and the inductance and capacity from tables found in some of the handbooks or computed from the fundamental formulas. The leakage for all ordinary commercial power lines can be considered as negligible. All line constants and voltages used in the computations are the quantities measured to *neutral*, and the currents used are currents per conductor.

USE HYPERBOLIC TABLES

It is necessary to obtain the complex hyperbolic functions (expressed as a vector)[5] of the $n\theta$ or electrical angle of the line (form 3, Fig. 3). These functions can be obtained directly from a table of complex hyperbolic functions. In taking the values from the tables it is necessary to interpolate both as regards quantity and angle. Another and probably more convenient way of getting at these functions, and the one which is used here, is to apply a reduction formula in which the hyperbolic quantity is expressed as any other vector; that is, with a real and an imaginary component. By doing this it is necessary to obtain only the hyperbolic sine and hyperbolic cosine of a simple number.[6] By the use of logarithms still more work is saved. The log hyperbolic sine and cosine of simple numbers can be obtained directly from tables, with one interpolation. "Smithsonian Mathematical Tables" contains an excellent table of these functions. There are also other tables published. To find the hyperbolic sine of $n\theta$, let $n\theta$ equal $u + jv$, where u is the real and v the imaginary part of the vector $n\theta$. It is then found that the hyperbolic sine of $n\theta$, or hyperbolic sine $(u + jv)$, is equal to $\sinh u \cos v + j \cosh u \sin v$, where

[1] "A Graphic Method for the Exact Solution of Transmission Lines," C. H. Holladay, *A. I. E. E. Journal*, November, 1922.

[2] "Circle Diagrams for Transmission Systems," R. D. Evans and H. K. Sels, *Electric Journal*, December, 1921, page 530.

[3] See Pender's "Handbook," page 1765.

[4] "Electrical Characteristics of Transmission Circuits," William Nesbit, Westinghouse Electric & Manufacturing Company.

[5] In this discussion vectors are expressed in two ways—in the $a + jb$ form, where a is the real component and b is the imaginary component, and in the exponential form A/a, where the actual length A of the vector is given, together with its angle from the reference vector. For purposes of addition the first is more convenient, and for purposes of multiplication, division and evolution the second is more convenient. If the $a + jb$ form is given and the exponential form is desired, A (length of vector) $= \sqrt{a^2 + b^2}$ and the angle is equal to $\tan^{-1} b/a$. If the exponential form is given and the $a + jb$ form is desired, it is obtained as follows: $a = A \cos a$, $b = A \sin a$.

[6] In case a table of hyperbolic functions is not available, it is a very simple matter to obtain the sinh and cosh for the particular value desired by means of the infinite series. Since the values desired are numerical ones and not vector quantities, the computation becomes simple multiplication and addition. The following are the series used:

$$\sinh x = x + \frac{x^3}{\underline{|3}} + \frac{x^5}{\underline{|5}} + \frac{x^7}{\underline{|7}} + \cdots\cdots$$

$$\cosh x = 1 + \frac{x^2}{\underline{|2}} + \frac{x^4}{\underline{|4}} + \frac{x^6}{\underline{|6}} + \cdots\cdots$$

Three terms are usually sufficient.

Example: To find sinh 0.05206:

$$\sinh 0.05206 = 0.05206 + \frac{0.05206^3}{1 \times 2 \times 3} + \frac{0.05206^5}{1 \times 2 \times 3 \times 4 \times 5}$$
$$= 0.05206 + 0.000,023,5 + 0.000,000,003$$
$$= 0.0520835$$
$$\log 0.0520835 = 8.71670 = \log \sinh 0.05206$$

It is seen that in this case even the third term is not necessary.

u and v are simple numerical quantities. The quantity v is expressed in radians, and in order to convert it to degrees multiply it by 57.296. Then u is a simple numerical quantity and v is an angle, expressed in degrees. From the tables referred to find the log of the hyperbolic sine of u and add to it the log cosine of angle v, which can be obtained from any log trigonometric table. The antilog of this gives the real term of the desired function (sinh $n\theta$). In the same way, by finding the product of the hyperbolic cosine of u and the sine of v, the imaginary term of the function (sinh $n\theta$) can be found. The desired hyperbolic function is thus obtained, only a few simple numerical computations having been performed and only linear interpolations having been made. In the same way the hyperbolic cosine can be found. The next step is to find the A, B, C and D constants of the line by substituting in the formulas given at the bottom of the form. Having these constants, any problem connected with the line itself may be solved.

Nearly every transmission line has transformers at one or both ends, and these transformers usually have a large influence on the regulation, power factor and voltage of the line. Mr. Evans and Mr. Sels[1] have pointed out a method whereby the constants of these transformers can be included with the A, B, C and D constants of the line, so that when the diagram is constructed it will

[1] "Transmission Lines and Transformers," R. D. Evans and H. K. Sels, *Electric Journal*, August, 1921, page 356.

Fig. 1

24-U-4

Trans. Line Computations

Date Jan. 24, 1925
Computed by R. G. H.
Checked by M. H. K.

TRANSMISSION LINE
Rio Grande Project
From Elephant Butte to El Paso, Texas

—o—

Predetermined and Assumed Design Data

Length, 120 miles.
Receiver load, 12,000 kw.
Nature of receiver load, General City Distribution.
Receiver power factor, 75–95%.
Rated line voltage, 110,000.
Receiver voltage, 110,000.
Allowable maximum supply voltage, 120,000.
Maximum altitude, ... feet above sea level.
Critical Disruptive Corona Voltage .....
Temperature extremes, ...°F. to .....°F.
Conductor loading assumed, ... "ice; # wind; .....°F.
Conductors, 266,800 c.m.–ALCSR.
Maximum allowable tension in conductors, ...
Spacing of conductors, 12'–0" Flat.
Equivalent spacing of conductors = $\sqrt[3]{a \times b \times c}$ = 15.12' delta.

Fig. 2

TRANSMISSION LINE—(Continued)

Electrical Design—Exact Hyperbolic Solution
(Halladay—A.I.E.E. Transactions, Vol. 41, p. 785)

Line Constants

n = length = 120 miles.
f = frequency = 60 cycles.
$w = 2\pi f$ = 377.0.
r = resistance = 0.350 ohms per mile at 77°F.
l = inductance = 0.002191 henrys per mile.
c = capacity = 0.01404×10^{-6} farads per mile.
g = leakance = Negligible ohms per mile.

Impedance $= r + jlw$.
$= 0.350 + j0.8260$ ohms per mile $(a + jb)$.
$= 0.8971/67°02'$ ohms per mile (exponential)

Admittance $= g + jcw$.
$= j5.293 \times 10^{-6}$ ohms per mile $(a + jb)$
$= 5.293 \times 10^{-6}/90°$ ohm per mile (exponential)

$\theta = \sqrt{(r + jlw) \times (g + jcw)} = \sqrt{0.8971/67°02' \times 5.293 \times 10^{-6}/90°}$.
$= 2.179 \times 10^{-3}/78°31'$ hyperbolic radians per mile.
$n\theta = 120 \times 2.179 \times 10^{-3}/78°31'$.
$= 0.2615/78°31'$ hyperbolic radians (exponential).
$= 0.05206 + j0.2563$ hyperbolic radians $(a + jb)$

Z_o = surge impedance $= \sqrt{\frac{(r + jlw}{(g + jcw}} = \sqrt{\frac{0.8971/67°02'}{5.293 \times 10^{-6}/90°}}$
$= 411.7\sqrt{11°29'}$ ohms (exponential).

Fig. 3

Hyperbolic Functions

To find Sinh $(n\theta)$ and Cosh $(n\theta)$

Sinh $(u + jv)$ = Sinh u Cos $v + j$ Cosh u Sin v
Cosh $(u + jv)$ = Cosh u Cos $v + j$ Sinh u Sin v

u = 0.05206	v = 0.2563	$\times$ 57.296° = 14.68°	= 14°41'
Log Sinh 0.05206	= 0.71670	Log Cosh 0.05206	= 0.00059
Log Cos 14°41'	= 9.98558	Log Sin 14°41'	= 9.40394
	8.70228		= 9.40453
Sinh u Cos v	= 0.05038	Cosh u Sin v	= 0.2538
Sinh $(n\theta)$	= 0.05038 + j0.2538 $(a + jb)$		
	= 0.2588/78°46' (exponential)		
Log Cosh 0.05206	= 0.00059	Log Sinh 0.05206	= 8.71670
Log. Cos 14°41'	= 9.98558	Log Sin 14°41'	= 9.40394
	9.98617		= 8.12064
Cosh u Cos v	= 0.9687	Sinh u Sin v	= 0.01320
Cosh $(n\theta)$	= 0.9687 + j0.01320 $(a + jb)$		
	= 0.9687/0°47' (exponential)		

Line Equations

$E_s = AE_r + BI_r$
$I_s = CE_r + DI_r$
A = Cosh $(n\theta)$ = 0.9687/0°47'
$B = Z_o$ Sinh $(n\theta)$ = $411.7\sqrt{11°29'} \times 0.2588/78°46'$
= 106.5/67°17' (exponential)
= 41.13 + j98.24 $(a + jb)$
$C = \frac{\text{Sinh } (n\theta)}{Z_o} = \frac{0.2588/78°46'}{411.7\sqrt{11°29'}}$
$= 10^{-3} \times 0.6286/90°15'$ (exponential)
$= -10^{-3} \times 2.743 + j10^{-3} \times 0.6286$ $(a + jb)$
$D = A$ (for symmetrical line).

Fig. 4

Inclusion of Effects of Terminal Transformers

The impedances only of the transformers are considered with the line. The admittance or charging currents are considered as part of the load.

A, B, C, D = constants of transmission line only.
A_o, B_o, C_o, D_o = constants of line with effect of terminal transformers included.
T_s = impedance of supply transformer (vector-ohms).
= 7.057 + j70.57 $(a + jb)$
= 70.92/84°17' (exponential)
T_r = impedance of receiver transformer (vector-ohms).
= 11.09 + j65.52 $(a + jb)$
= 66.45/80°24' (exponential)

$A_o = A + C\,T_s$
$= 0.9687 + j0.01320 - 0.04438 + j0.00425$
$= 0.9243 + j0.01745$ $(a + jb)$
$= 0.9245/1°05'$ (exponential)
$C\,T_s = 0.6286 \times 10^{-3}/90°15' \times 70.92/84°17'$
$= 0.04458/174°32'$ (exponential)
$= -0.04438 + j0.00425$ $(a + jb)$

$B_o = B + A(T_r + T_s) + C\,T_r\,T_s$
$T_r + T_s = 18.147 + j136.09$ $(a + jb)$
$= 137.2/82°24'$ (exponential)
$A(T_r + T_s) = 0.9687/0°47' \times 137.2/82°24'$
$= 133.0/83°11'$ (exponential)
$= 15.79 + j132.1$ $(a + jb)$
$C\,T_r\,T_s = 0.6286 \times 10^{-3}/90°15' \times 66.45/80°24' \times 70.92/84°17'$
$= 2.962/254°56'$ (exponential)
$= -0.7699 - j2.860$ $(a + jb)$
$B_o = 41.13 + j98.24 + 15.79 + j132.1 - 0.7699 - j2.860$
$= 56.15 + j227.48$ $(a + jb)$
$= 234.3/76°08'$ (exponential)
$C_o = C$.

Fig. 5

$D_o = A + C\,T_r$ . . . $C\,T_r = 0.6286 \times 10^{-3}/90°15' \times 66.45/80°24'$
$= 0.9687 + j0.01320 - 0.04121 + j0.00679$
$= 0.04177/170°39'$ (exponential)
$= 0.9275 + j0.01999$ $(a + jb)$
$= -0.04121 + j0.00679$ $(a + jb)$
$= 0.9277/1°14'$ (exponential)

Loss Circle Constants

(See Memo., dated 1-1-1925, filed in General Data File 208–GD–1 — for construction & use of loss circle diagram)

$A_o = a_o + ja_o$	$a_o = 0.9243$
	$a_o = 0.01745$
$B_o = R_o + jX_o$	$R_o = 56.15$
	$X_o = 227.48$
$C_o = g_o + jb_o$	$g_o = -2.743 \times 10^{-3}$
	$b_o = 0.6286 \times 10^{-3}$
$D_o = d_o + jd_o$	$d_o = 0.9275$
	$d_o = 0.01999$
$k = R_o g_o + X_o b_o + a_o d_o + a_o d_o - 1$	$= 0.477 \times 10^{-3}$
$m = a_o g_o + a_o b_o$	$= 8.43 \times 10^{-3}$
$n = d_o R_o + d_o X_o$	$= 56.63$
$t = X_o g_o - R_o b_o + a_o d_o - a_o d_o$	$= -0.0336$

Simplified Loss Circle Constants

Use these formulas when the sending and receiving transformers are symmetrical, and for the line only, when leakance is negligible.

$k = 0$ (approximate)
$m = a_o b_o$ = ...
$n = a_o R_o + a_o X_o$ = ...
$t = -R b_o$ = ...

Fig. 6

Vectors for Assumed Conditions

Receiver voltage to neutral $= \frac{110{,}000}{\sqrt{3}} = 63{,}510 = E_r$

No-load supply volts $= A_o E_r = 0.9245/1°05' \times 63{,}510$
$= 58{,}720/1°05'$

Charging current $= C_o E_r = 0.6286 \times 10^{-3}/90°15' \times 63{,}510$
$= 39.92/90°15'$

Receiver current for 12,000 kw. $= \frac{K.W. \times 1{,}000}{E_r \times 3} = I_r$ amps.
$= \frac{12{,}000 \times 1{,}000}{63{,}510 \times 3} = 62.98$

Impedance drop (12,000 kw.) $= B_o I_r = 234.3/76°08' \times 62.98$
$= 14{,}760/76°08'$

Load current (12,000 kw.) $= D_o I_r$ (= $A_o I_r$ for symmetrical system)
$= 0.9277/1°14' \times 62.98$
$= 58.43/1°14'$

Determination of Scales for Vector Diagram

Ratio between current and voltage scales
$= \frac{B_o I_r}{D_o I_r} = \frac{B_o}{D_o}$ = (numeric)
$\frac{234.3}{0.9277} = 252.6$

Ratio between power and voltage scales
$= \frac{\text{Any assumed power in kw.}}{\text{Impedance drop in volts for same power}}$
$\frac{12{,}000}{14{,}760} = 0.8132$

Scales

1 inch = 3000 kw. — 1000 Volts = 0.2710 inch
1 inch = 3690 volts — 1 amp. = 0.0684 inch
1 inch = 14.61 amps.

Fig. 7

Loss Circles

Center of Circles

$P = -\frac{k E_r'}{1154.4\,n} - \frac{0.477 \times 10^{-3} \times 67{,}510^2}{1154.4 \times 56.63} = -30$

$Q = -\frac{t E_r'}{1154.4\,n} - \frac{-0.0336 \times 67{,}510^2}{1154.4 \times 56.63} = 2073$

Radius $= \frac{E}{577.2}\sqrt{\frac{L}{n} + (k^2 + t^2 - 4mn)\frac{E_r'^2}{2309\,n^2}}$

Note:
E is always voltage to neutral
$+Q$ is plotted in the direction of lagging power factor
Radius is plotted to the same scale as power in kw.

No.	L Loss in Watts	$\frac{L}{n}$	$(k^2+t^2-4mn)\frac{E_r'^2}{2309\,n^2}$	Radius
1	100×10^3	1766	−425	4030
2	200×10^3	3530	"	6130
3	400×10^3	7065	"	8960
4	600×10^3	10,595	"	11,090
5	800×10^3	14,125	"	12,880
6	1000×10^3	17,660	"	14,450
7	1200×10^3	21,190	"	15,850
8	1400×10^3	24,720	"	17,150
9	1600×10^3	28,255	"	18,350
10	1800×10^3	31,785	"	19,480
11	2000×10^3	35,315	"	20,540

FIGS. 1 TO 7—FORMS USED TO FACILITATE TRANSMISSION-LINE CALCULATIONS

take into account the effect of these transformers. The method indicated in the forms is approximate, with an error usually less than 1 per cent, since the impedances only of the transformers are considered, the charging current being considered as part of the load. If a more exact solution is desired, it can be obtained by using a somewhat longer and more complicated formula.

The next sheet (Fig. 4) is to be used for making this combination. It is necessary to know the impedances of the transformers. This is usually given or expressed as a certain per cent voltage drop for resistance and reactance at a given load and voltage. It is easy to convert this to equivalent resistance in ohms, expressed as a vector quantity, the resistance being the real component of the vector and the reactance

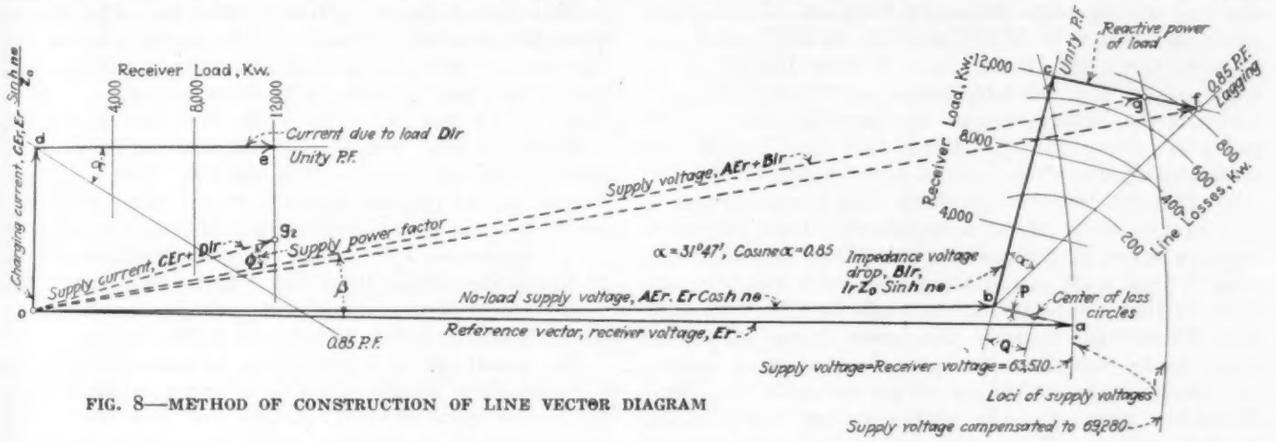


FIG. 8—METHOD OF CONSTRUCTION OF LINE VECTOR DIAGRAM

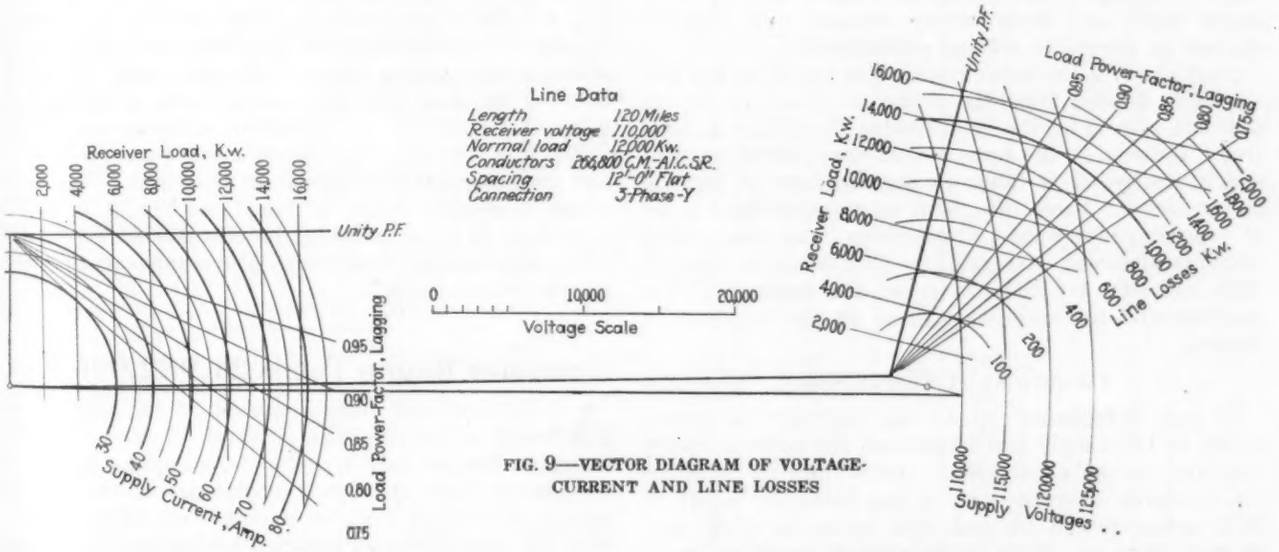


FIG. 9—VECTOR DIAGRAM OF VOLTAGE-CURRENT AND LINE LOSSES

ohms being the imaginary component. Let A_0, B_0, C_0 and D_0 be the constants of the line with the effects of the transformers added. The formulas are self-explanatory. After these combined constants are obtained, they are substituted in the fundamental line equations, as if they were the constants for the line only.

In order to draw the loss circles on the diagram, it is necessary to obtain k, m, n and t. These are obtained directly from the A, B, C and D constants as shown in Fig. 5. In most cases the approximate formulas as given at the bottom of the sheet are sufficiently accurate.

The next step is to determine the vectors and scales necessary to draw the diagram. These operations are performed on form 6 (Fig. 6). The no-load voltage at the supply end is the product of the receiver voltage to neutral and the A constant. It is usually less than the voltage at the receiver end. The charging current is the product of the receiver voltage and the C constant. For constructing the diagram a unity power factor at the receiving end of the line is assumed. The impedance drop is the product of the receiver current and the B constant. The current at the supply end due to load at the receiver end is the product of the receiver current and the D constant. The voltage to neutral at the supply end is equal to the sum of the no-load supply voltage and the impedance drop, added vectorially, and the current at the supply end is equal to the sum of the charging current and the load current, added vectorially.

The ratio between the current and the voltage scales is equal to the ratio between the B and D constants. In determining this ratio use the numerical part only and neglect the angles. The ratio between the power and voltage scales is obtained by dividing any given power value by the value of the voltage drop at that power due to impedance. The impedance drop for a given power has already been computed. Divide that power by the impedance drop to obtain the ratio between the scales. Now, having determined the ratio between the current, voltage and power scales, if a value is assigned to any one of the above, the scales for the other two can be determined. Since most of the values of the diagram are expressed in terms of power, it is advisable to choose a power scale corresponding to one of the divisions on an ordinary engi-

neer's scale. For the example illustrated one inch was chosen to represent 3,000 kw. Then it followed that one inch represented 3,690 volts and 14.61 amp.

Form 7 (Fig. 7) is used for obtaining the co-ordinates of the loss circles and the radii for various losses. The *k*, *m*, *n* and *t* constants from form 5 are used, and the computations are all arithmetical ones. This completes the computations, and the diagram can be drawn. Fig. 8, which is a diagram in skeleton form, illustrates the procedure.

Draw the line *oa* equal in length to the receiver voltage assumed. This line is the reference vector, and the phase angle of all the vectors on the diagram are measured from this line, with *o* as a center. Draw the line *ob* equal in length to the no-load sending voltage and at the angle indicated from *oa*. In this diagram it is equal to 58,720 volts at an angle of 1 deg. 05 min. from *oa*. From point *b* draw line *bc* at an angle of 76 deg. 08 min. from *oa*. This line is the locus of the supply voltage for varying loads at 100 per cent power factor. Along this line lay off any convenient power divisions, as 4,000, 8,000, 12,000 kw., etc. Through these points draw lines perpendicular to *bc*. Spaces along these perpendicular lines represent reactive power at a given load and power factor. From point *b* draw a set of radiating lines with such an angle from *bc* that the cosine of the angle is 0.95, 0.90, 0.85, etc. These lines indicate the power factor of the receiver load. With *o* as a center draw a set of concentric circles representing the supply voltage. The circle through *a* represents the supply voltage equal to the receiver voltage. The others are drawn with proportional radii and show supply voltage with varying degrees of generator voltage compensation.

Next draw in the loss circles. The center of the loss circles is located from the center *b* of the power co-ordinate system by the co-ordinates *P* and *Q*. A positive *P* is taken in the same direction as positive power, and a positive *Q* is taken in the direction of lagging power factor. From this point as a center draw a set of concentric circles representing any convenient amounts of power with radii as determined on form 7. This completes the voltage, power and loss part of the diagram and in many cases gives all the information desired.

CONDITIONS AT SUPPLY END

In case information about the current and power factor at the supply end is desired, the current vector diagram can be constructed. Draw line *od* equal to the charging current—i.e., in the example, equal to 39.92 amp. or 2.73 in. and with an angle of 90 deg. 15 min. from *oa*. This is the current required by an open line, due to the capacity of the conductors. Point *d* now forms the center of a system of power co-ordinates the same as point *b*, with line *de* representing power at unity power factor, the same as line *bc*. Line *de* is drawn at an angle of 1 deg. 14 min. from line *oa*, as indicated by the angle of the vector, DI_r. In the same way and to the same scale as before lines are drawn in at right angles to represent the reactive power, and radial lines are drawn with *d* as a center to indicate load power factor. It is usually convenient to draw a set of concentric circles with *o* as a center to indicate values of supply amperes. These are drawn corresponding to the ampere scale and may be made for any convenient values, such as 5, 10, 15, 20, etc., amp.

An example will serve to illustrate the use of the diagram. Consider a load at the receiver end of 12,000 kw. at 85 per cent power factor. Locating this load on the voltage-power diagram at the intersection of the 85 per cent power-factor line with the 12,000-kw. load line gives point *f*. It is seen immediately that this is so far beyond the receiver voltage that it is not feasible to compensate the generator voltage enough to take care of the line drop. Assume, then, that the generator voltage may be raised from 110,000 volts (63,500 to neutral) to 120,000 volts (69,280 to neutral). Locating the intersection of the 12,000-kw. power line and the circle representing 120,000 volts at the supply end gives point *g*, as shown in Fig. 8. The distance *fg* represents the amount of synchronous condenser capacity which must be added to raise the load to this power factor. It is 2,800 kva. The line *og* gives the generator voltage and its phase relation with the receiver voltage. It is 69,280 volts or 120,000 volts line to line, and it leads the receiver voltage by angle β, equal to 11 deg. 41 min. The line loss under this condition is read directly by the position of *g* in respect to the loss circles. It is 740 kw. Point g_s is now located on the current diagram at the same place as *g* on the voltage diagram by means of a pair of dividers or by inspection. The line og_s gives the line current at the supply end. It is found to be 61.6 amp. The power factor at the supply end is the cosine of angle ϕ, which is cosine 5 deg. 39 min., or 0.995 leading.

For actual use it is convenient to make the diagram more complete by the addition of more subdivisions to the power, power-factor, voltage and loss lines. The appearance of a diagram ready for use is shown by Fig. 9. The above method can be used on the greater number of transmission-line problems that arise in the average engineering office. However, once the principle of the diagrams and computations is grasped, it is readily seen that it is capable of many variations. If the line only is to be studied, form 4 can be left out and the computations carried on as before. The Z_o or surge impedance which is found on Fig. 2 is useful if a study is to be made of the effect of surges on the line. The method should also prove applicable to telephonic transmission.[8]

Generator Rating Totals 21,932,996 Kva.

A TABULATION just completed of the data to be found in the McGraw Central Station Directory indicates that on July 1, 1924, the generator rating of the electric light and power companies of the country totaled 21,932,996 kva., an increase of 4,032,996 kva. over the total figure as reported by the Census Bureau for January 1, 1923. That is, the operations of the industry appear to have increased by 22.6 per cent during the eighteen-month period. Of the total rating, 0.61 per cent was reported as "reserve equipment." The total rating of the direct-current generators was 308,680 kw., or 1.47 per cent of the total rating of the country.

The Middle Atlantic States led in the total rating of installed generators with 5,280,923 kva., followed very closely by the East North Central States with 5,268,239 kva. The South Atlantic States appear to have passed both the Pacific and New England States since the

[8] In addition to the references already made the following may prove useful in further study of the subject: "Electrical Phenomena in Parallel Conductors," F. E. Pernot, and "Engineering Mathematics," C. P. Steinmetz. Chapter I of the latter gives an excellent review of the method of expressing electrical quantities by means of vectors.

Census Bureau survey of 1922 and now stand third with 2,789,339 kva. The West South Central States reported the highest percentage reserve equipment with 20,453 kva., or 2.23 per cent of the total.

New York easily leads in the total generator installation with 2,663,628 kva., followed by Pennsylvania with 2,163,552 kva. California stands third with 1,721,981 kva. The largest installation of direct-current generators was reported by Illinois with a total of 54,658 kw.

Data on the various frequencies employed are also to be found in the accompanying table. Of the 3,066 companies reporting frequencies, 2,577, or 83.8 per cent, reported the use of three-phase, 60 cycle, and 241, or 7.9 per cent, reported two-phase, 60-cycle. A number of companies also reported the use of three-phase, 25-cycle, single-phase, 60-cycle, and single-phase, 133-cycle. In all nineteen different frequencies were reported.

A total of 1,858 companies reported the purchase of all their energy, and 326 reported that they both generate and purchase. The West North Central States reported the greatest number of companies purchasing all their energy.

Data on Generators Installed in the Central Generating Plants of the Country

(As of July 1, 1924)

State and Section	Generator Rating					Number of Companies Reporting Use of Various Frequencies*					Number of Companies Purchasing All Their Energy	Number of Companies Which Purchase and Generate
	Total Kva.	A.C. (Active) Kva.	A.C. (Reserve) Kva.	D.C. (Active) Kw.	D.C. (Reserve) Kw.	3-25	1-60	2-60	3-60	1-133		
United States	21,932,996	21,487,478	133,838	303,929	4,751	56	154	241	2,577	10	1,858	326
New England	1,907,869	1,875,343	9,205	23,071	250	4	6	14	151	..	159	49
Middle Atlantic	5,280,923	5,218,269	28,868	33,281	505	23	21	70	188	1	227	47
South Atlantic	2,789,339	2,751,511	15,114	21,399	1,315	4	13	26	354	2	204	37
East North Central	5,268,239	5,119,466	34,973	112,725	1,075	13	40	48	461	3	471	72
West North Central	1,495,870	1,439,377	11,530	43,542	1,421	8	20	35	550	..	485	56
East South Central	771,696	746,133	4,199	21,214	150	0	25	6	173	1	51	11
West South Central	958,495	907,544	20,418	30,498	35	1	15	25	397	1	118	17
Mountain	1,066,165	1,052,487	6,588	7,090	0	3	6	7	197	1	62	18
Pacific	2,394,400	2,380,348	2,943	11,109	0	0	8	10	106	1	81	19
NEW ENGLAND												
Maine	207,520	206,713	257	550	0	...	3	1	33	..	36	8
New Hampshire	46,107	45,712	187	208	0	2	1	4	24	..	13	4
Vermont	115,413	114,177	344	892	0	...	1	2	27	..	24	10
Massachusetts	1,098,531	1,072,198	8,417	17,666	250	1	1	3	44	..	69	15
Rhode Island	179,035	176,000	0	3,035	0	1	...	...	3	..	9	2
Connecticut	261,263	260,543	0	720	0	...	...	4	20	..	8	10
MIDDLE ATLANTIC												
New York	2,663,628	2,648,598	3,989	11,041	0	15	9	42	76	1	112	29
New Jersey	453,743	440,494	11,994	750	505	...	6	10	27	..	21	4
Pennsylvania	2,163,552	2,129,177	12,885	21,490	0	8	6	18	85	..	94	14
SOUTH ATLANTIC												
Delaware	41,875	39,165	125	2,585	0	...	1	...	5	..	6	3
Maryland	280,304	278,167	1,297	665	175	1	1	4	18	..	15	1
Dist. of Columbia	98,000	98,000	0	0	0	1	...	...	1	..	2	0
Virginia	274,092	266,879	306	6,907	0	1	1	3	52	..	12	5
West Virginia	489,483	484,673	450	4,360	0	...	5	3	27	1	30	5
North Carolina	862,150	858,845	2,655	650	0	...	2	1	69	..	59	9
South Carolina	205,283	200,170	1,638	3,025	450	...	1	1	48	..	22	1
Georgia	447,323	442,300	2,306	2,027	690	1	2	11	82	1	41	10
Florida	90,829	83,312	6,337	1,180	0	...	...	3	52	..	17	3
EAST NORTH CENTRAL												
Ohio	1,509,475	1,469,467	10,710	29,298	0	9	8	9	93	2	132	10
Indiana	597,449	589,689	4,012	3,248	500	...	5	6	71	..	108	8
Illinois	1,696,348	1,635,920	5,770	54,108	550	...	10	11	89	1	102	16
Michigan	862,842	856,852	453	5,512	25	1	11	13	95	..	35	9
Wisconsin	602,125	567,538	14,028	20,559	0	3	6	9	113	..	94	29
WEST NORTH CENTRAL												
Minnesota	212,315	204,001	2,033	5,920	361	...	1	7	73	..	107	11
Iowa	387,140	371,959	1,238	13,878	65	1	3	14	76	..	90	14
Missouri	486,866	473,336	3,740	9,000	790	5	10	5	98	..	57	6
North Dakota	16,778	10,319	1,063	5,316	80	...	1	1	31	..	33	9
South Dakota	38,585	36,558	600	1,377	50	...	...	1	46	..	32	3
Nebraska	153,973	146,916	894	6,088	75	...	2	1	98	..	87	4
Kansas	200,213	196,288	1,962	1,963	0	2	3	6	128	..	79	9
EAST SOUTH CENTRAL												
Kentucky	169,100	161,047	955	7,098	0	...	4	...	39	..	18	2
Tennessee	294,573	284,165	762	9,646	0	...	6	2	55	..	15	6
Alabama	246,084	242,080	2,482	1,372	150	...	3	2	31	..	16	3
Mississippi	58,939	55,841	0	3,098	0	...	12	2	48	1	2	0
WEST SOUTH CENTRAL												
Arkansas	81,826	75,689	944	5,193	0	...	1	6	56	..	13	2
Louisiana	127,304	120,362	0	6,942	0	...	3	4	51	..	58	5
Oklahoma	161,306	145,729	12,502	3,075	0	...	4	5	94	..	19	5
Texas	588,059	565,764	6,972	15,288	35	1	7	10	196	1	28	5
MOUNTAIN												
Montana	469,550	467,948	437	1,165	0	...	3	1	28	..	9	3
Idaho	81,304	79,621	1,126	557	0	...	...	1	24	..	...	...
Wyoming	36,463	36,231	200	32	0	...	...	...	29	..	8	0
Colorado	189,567	182,391	2,900	4,276	0	1	1	1	47	..	17	8
New Mexico	17,823	17,138	0	685	0	...	1	1	19	1	1	0
Arizona	64,159	61,934	1,925	300	0	2	...	3	18	..	11	2
Utah	192,302	192,227	0	75	0	...	1	...	24	..	11	3
Nevada	14,997	14,997	0	0	0	...	...	...	8	..	5	2
PACIFIC												
Washington	463,309	452,983	250	10,076	0	...	3	2	39	..	39	9
Oregon	209,110	208,322	693	95	0	...	4	1	33	1	12	3
California	1,721,981	1,719,043	2,000	938	0	...	1	7	34	..	30	7

* The following frequencies were also reported: 1-25, one in New York; 2-25, one in New York; 2-30, one in Idaho; 3-30, one in Michigan; 3-33, one in Oregon; 3-40, one in Massachusetts, five in New York and two in South Carolina; 3-50, one in Maryland; 1-62, one in Illinois; 2-62½, two in New York and one in Arizona; 1-125, one in New York; 3-125, one in New York; 2-133, two in New York; 3-133, one in Pennsylvania, one in Virginia, one in Michigan and one in Wisconsin; 1-140, one in Vermont and one in Mississippi.

High-Voltage Circuit Breaker Tests

Tests Made at 132 Kv. at Canton, Ohio, Show that Capacities of 725,000 Kva. Can Be Interrupted Successfully—Breaker Stands Seven Shots at One-Minute Intervals —Details of Connections and Results Observed

By P. SPORN and H. P. ST. CLAIR
Electrical Engineering Department, American Gas & Electric Company, New York

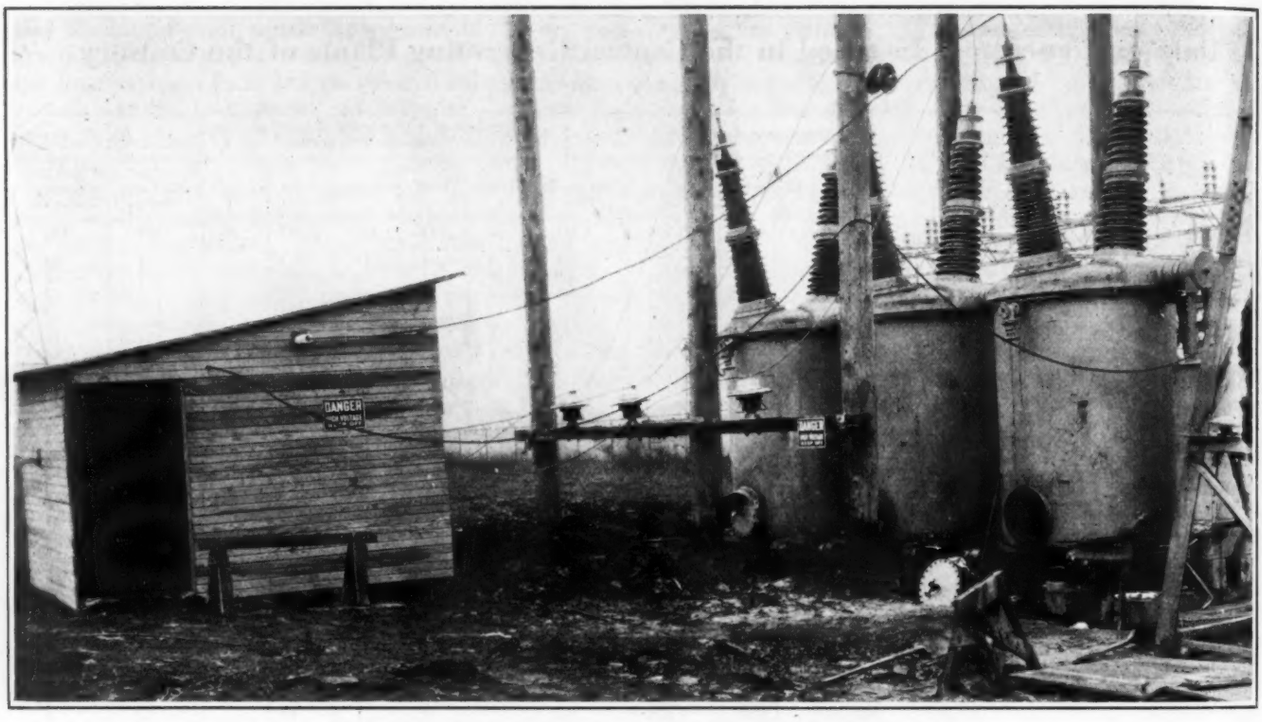


FIG. 1—GENERAL MOUNTING OF CIRCUIT BREAKER FOR TESTS

INTERRUPTING capacity tests on a 150-kv. oil circuit breaker were conducted on March 8, 1925, and again on April 19, 1925, by the American Gas & Electric Company at the Sunnyside substation of the Ohio Power Company at Canton, Ohio. These tests were carried out to determine the adaptability of this type of breaker, which has been recently developed by Brown, Boveri & Company of Baden, Switzerland, for use in high-tension lines carrying large blocks of power. The tests were carried out beginning with limited system capacity and finally increasing to the maximum capacity available on the system, including interconnections with other systems.

The general appearance of the breaker tested is shown in Fig. 1. The breaker tanks have a diameter of 65½ in. and a height from truck rail to center line of horizontal operating shaft of 8 ft. 10 in. As will be noted in this illustration, manholes are provided in the side at the bottom of the tanks, leaving the tank covers completely tight except for a baffled vent for the relief of gas pressure. The breaker is closed by means of a universal motor and operating mechanism and is tripped by an independent trip coil.

The multiple break contacts of this breaker are shown in Figs. 2 and 3. Fig. 2, a horizontal view looking into the breaker tank through the manhole, shows some of the lower moving contacts (which are spring mounted) and Fig. 3 shows the stationary upper contact assembly in an inverted position. These upper contacts are rigidly attached to the lower end of the bushings and engage with the lower contacts of Fig. 2, making a total of ten breaks in series. Fig. 3 also shows one group of baffles which are placed between the breaks to prevent flashing across.

As shown in Fig. 1 and in Fig. 5, one side of the breaker was connected to the 132-kv. Alliance line just outside the substation yard and the other side was connected through current transformers to a common short-circuit point, which was in turn connected to a 2-in. ground pipe. Since indoor type current transformers were employed, the shed shown in Fig. 1 was built to protect them from moisture. The breaker itself was mounted on heavy timber supports and the tanks were grounded to several ground pipes independent from the short-circuit point and other grounds.

The oscillographic records were obtained by means of equipment furnished and operated by Prof. H. E. Dyche, assisted by Prof. E. R. Rath, both of the University of Pittsburgh. The oscillograph had been modified and equipped by Professor Dyche particularly to adapt it for recording rupturing capacity tests, the outstanding feature being an arrangement such that by the throwing of one switch the circuit breaker was closed, followed by the automatic starting of the oscillograph film after the proper time delay to allow for the mechanical delay in the breaker closing. Another fea-

ture, obtained by the use of a standard amateur camera film roll and a special trip device to stop the film at a predetermined travel, made it possible to record several breaker operations with intervals as low as ten or fifteen seconds, all on one film. An oscillogram taken in this way is shown in Fig. 9, the interval in this case being one minute.

The system connections for the tests made on March 8 and April 19 are shown in Figs. 4 and 6 respectively. A brief description of the tests made on each day, with references to the system diagrams, follows:

The series of tests made March 8 was begun with reduced system capacity, the first test consisting of a standard new duty cycle, OCO—2 minutes —OCO, with four generators at the Windsor plant only. All the reactors at Windsor were in the circuit as shown in Fig. 4. The short circuit, about 240,000 kva., was cleared by the test breaker with no distress. A repetition of this test with the reactors at Windsor short-circuited and the Canton condensers added increased the short circuit to approximately 285,000 kva., which was also cleared with no distress.

After this test, No. 2 tank was drained and the contacts and interior of the tank were examined. The contacts showed some burning, and the oil, G. E. No. 21, showed slight discoloration. The tank was refilled and tests were continued without changing or dressing contacts, or changing oil in the two other tanks.

With the same setup as on the last test, a special duty cycle of eight "shots" separated by approximately ten seconds was taken, rupturing from 330,000 to 340,000 kva. on each shot. A small amount of smoke coming from the vents and a slight movement of the tanks were the only visible indications of breaker operation. Oil samples showed only moderate discoloration and tested 27 kv. average, as against 28.5 kv. at the beginning of tests. (Breakdown voltage between 1-in. electrodes, 0.1 in. apart).

The final test, a standard duty cycle with all the capacity shown in Fig. 4 connected, is recorded on the oscillograms of Fig. 7. The short circuit, approximately 530,000 kva. on both shots, was cleared by the test breaker without distress. Some smoke was emitted from the vents and a very noticeable movement of the tanks was observed. This movement in all probability was aggravated by the resilient character of the foundation. Samples of the oil, which was not changed during the entire series of tests, showed partial discoloration and tested from 24 to 25 kv. The extent of burning on the contacts is illustrated by Fig. 8. This burning was not considered sufficiently heavy to affect the condition of the breaker for closing and carrying its rated current.

TESTS AT MAXIMUM SYSTEM CAPACITY

On April 19 tests were made with increased system capacity as shown in Fig. 6. After the March 8 tests the contacts were dressed and the oil was filtered until it withstood a test of approximately 30 kv.

On the first test, a standard duty cycle, approximately 725,000 kva. was obtained and ruptured successfully. The movement of the tanks was greater than on previous tests and somewhat more smoke was emitted from the vents. On the second shot of this test No. 1 pole gave off much more smoke than the two other poles, and threw an appreciable quantity of oil. The other tanks threw only a very slight amount of oil. The back-up breaker opened on this shot, but not before the circuit had cleared. Apparently the arc in this phase held long enough to close the relay contacts, although the oscillogram of No. 3 phase showed that the current in No. 3 pole was cleared in about eighteen cycles (total time from closing breaker to complete interruption of current), the same as in other tests. An examination of the interior of No. 1 tank at the end of the day's tests showed that one of the barriers between the breaks had been charred badly on both

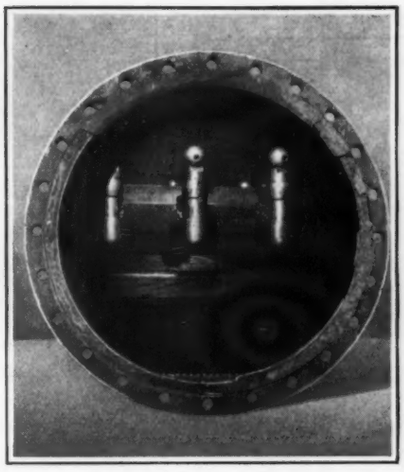


FIG. 2—HORIZONTAL VIEW OF MOVING CONTACTS

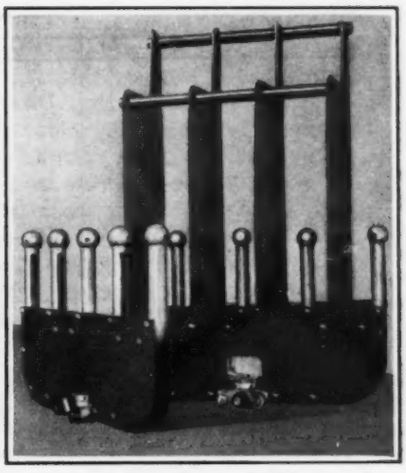


FIG. 3—STATIONARY UPPER CONTACT ASSEMBLY IN AN INVERTED POSITION

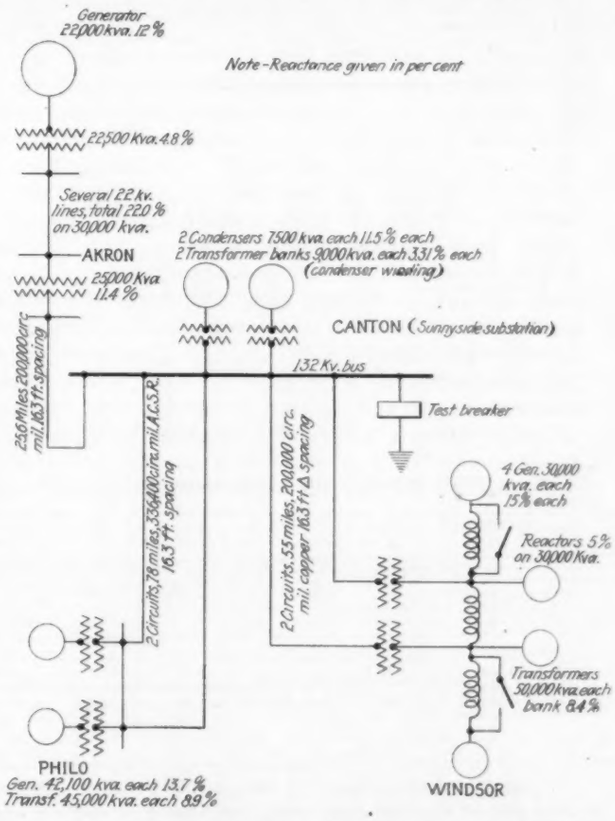

Generator 22,000 kva. 12 %
Note - Reactance given in per cent
22,500 Kva. 4.8 %
Several 22 kv. lines, total 22.0 % on 30,000 kva.
AKRON
25000 Kva. 11.4 %
2 Condensers 7500 kva. each 11.5 % each
2 Transformer banks 9000 kva. each 33.1 % each (condenser winding)
CANTON (Sunnyside substation)
132 Kv. bus
Test breaker
4 Gen. 30,000 kva. each 15% each
Reactors 5% on 30,000 Kva.
Transformers 50,000 kva. each bank 8.4 %
WINDSOR
PHILO
Gen. 42,100 kva. each 13.7 %
Transf. 45,000 kva. each 8.9 %
256 Miles 200,000 circ. mil, 16.3 ft. spacing
2 Circuits, 78 miles, 336,400 circ. mil A.C.S.R. 16.3 ft. spacing
2 Circuits, 55 miles, 200,000 circ. mil. copper 16.3 ft Δ spacing

FIG. 4—SYSTEM DIAGRAM FOR TESTS MADE ON MARCH 8

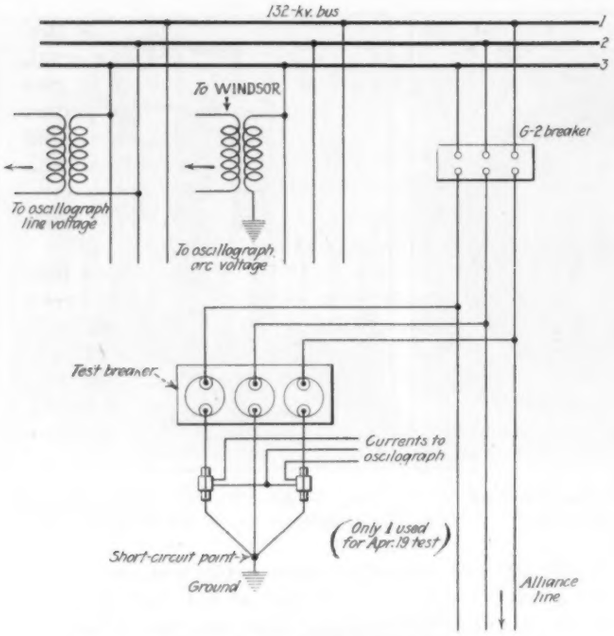


FIG. 5—OIL CIRCUIT BREAKER TEST CONNECTIONS

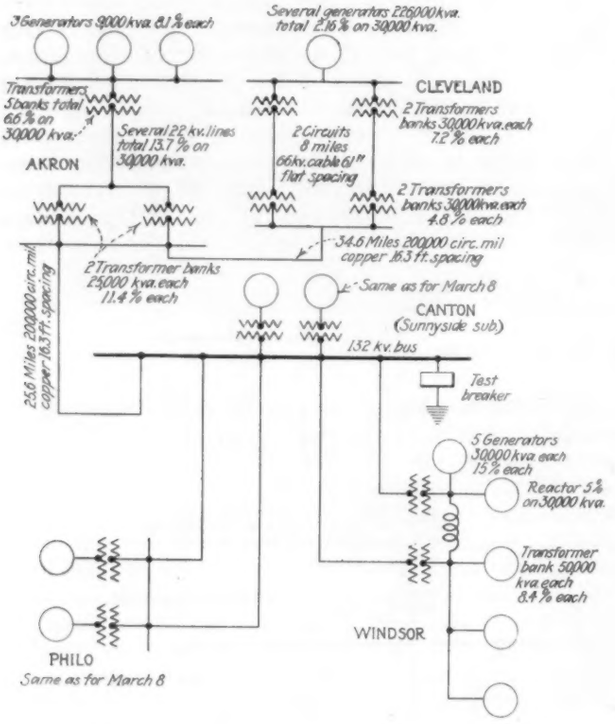

3 Generators 9000 kva. 8.1 % each
Several generators 226000 kva. total 2.16 % on 30000 kva.
Transformers 5 banks total 6.6 % on 30000 kva.
Several 22 kv. lines total 13.7 % on 30000 kva.
AKRON
CLEVELAND
2 Transformers banks 30000 kva. each 7.2 % each
2 Circuits 8 miles 66 kv. cable 61" flat spacing
2 Transformers banks 30000 kva. each 4.8 % each
34.6 Miles 200000 circ. mil copper 16.3 ft. spacing
2 Transformer banks 25000 kva. each 11.4 % each
25.6 Miles 200000 circ. mil copper 16.3 ft. spacing
Same as for March 8
CANTON (Sunnyside sub)
132 kv. bus
Test breaker
5 Generators 30000 kva. each 15 % each
Reactor 5 % on 30000 kva.
Transformer bank 50000 kva. each 8.4 % each
WINDSOR
PHILO
Same as for March 8

FIG. 6—SYSTEM DIAGRAM FOR TESTS MADE ON APRIL 19

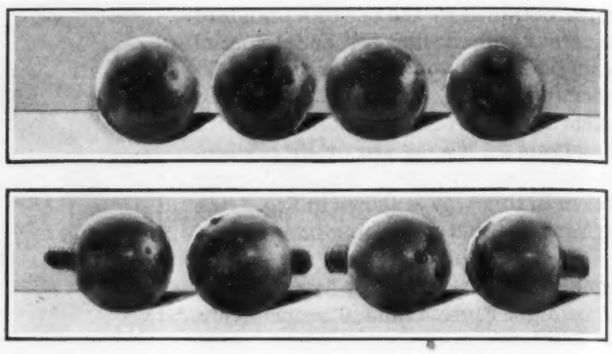


FIG. 8—SIDE AND END VIEWS OF SPHERICAL CONTACTS AFTER TESTS OF MARCH 8

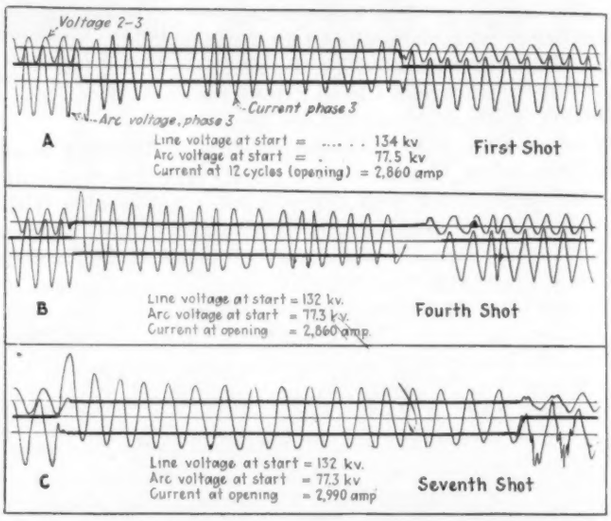

Voltage 2-3
Current phase 3
Arc voltage, phase 3
A
Line voltage at start = ... 134 kv
Arc voltage at start = ... 77.5 kv
Current at 12 cycles (opening) = 2,860 amp
First Shot
B
Line voltage at start = 132 kv.
Arc voltage at start = 77.3 kv.
Current at opening = 2,860 amp.
Fourth Shot
C
Line voltage at start = 132 kv.
Arc voltage at start = 77.3 kv
Current at opening = 2,990 amp
Seventh Shot

FIG. 9—OSCILLOGRAMS OF SPECIAL DUTY CYCLE TEST OF SEVEN SHOTS AT ONE-MINUTE INTERVALS

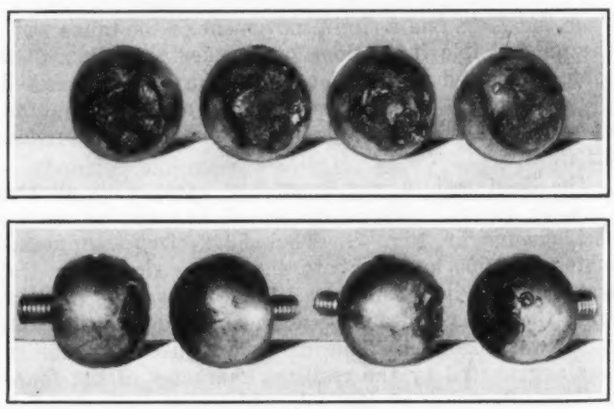


FIG. 10—SIDE AND END VIEWS OF SPHERICAL CONTACTS AFTER TESTS OF APRIL 19

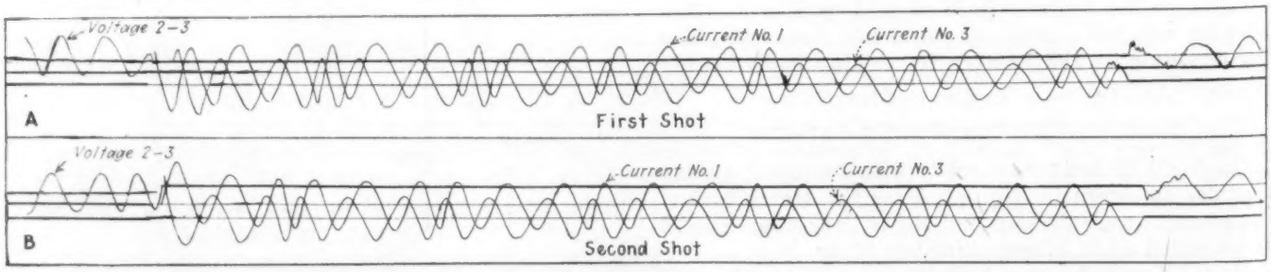


FIG. 7—OSCILLOGRAMS OF BREAKER RUPTURING APPROXIMATELY 530,000 KVA. ON STANDARD NEW DUTY CYCLE

A. **First shot of standard duty cycle. The initial voltage was 135,000 volts and the restored voltage 109,000 volts. Current No. 1 at opening was 2,260 amp. Current No. 3 at opening was 2,180 amp.**

B. **On the second shot the initial voltage was 141,000 and when restored 96,000 volts. Current No. 1 at opening was 2,180 amp. Current No. 3 at opening was 2,100 amp.**

sides opposite the breaks. This particular barrier was a replacement obtained locally for one of the original barriers which had been broken in assembling the breaker. The exact material of and extent of damage to this barrier has not as yet been determined, but the present theory is that the replacement material is more subject to burning than the manufacturer's own barrier material and therefore that this burning, with possible generation of gases tending to maintain the arc longer, was the cause of increased distress in this pole. None of the other barriers showed any burning and apparently this barrier was not punctured. The phenomenon was not repeated on any of the subsequent tests with practically the same system set up.

For the second test, another standard duty cycle, the system set up was the same except that only four generators, two on each bank, were available at Windsor. On each shot the breaker cleared approximately 675,000 kva., with no apparent difficulty.

The final test consisted of a special duty cycle of seven shots at one-minute intervals with the system connections the same as for the second test. A partial oscillographic record of this test is shown in Fig. 9, and the condition of the contacts after all the tests in Fig. 10. Regarding the one-minute interval, it should be stated that this was increased to two minutes between the third and fourth shots to permit changing a film. The ruptured capacity, as indicated by the oscillograms, varied from 650,000 to 685,000 kva., as compared with a calculated value of 720,000 kva., allowing for the current decrement at 0.2 second from the instant of closing on the short circuit.

The arc voltage records on the oscillograms show that the breaker required approximately six cycles to break the arc, the time being measured from the first indication of arc voltage to the final clearing of the circuit.

All the shots were cleared with no evidence of distress except the emission of a small amount of smoke and slight spray of oil from the vents and the movement of the tanks.

The condition of the contacts at the end of the series of tests and the extent of the burning are shown in Fig. 10. This burning was not considered sufficiently heavy to affect the condition of the breaker for closing and carrying its rated current. The oil, though quite discolored, tested about 25 kv.

Accuracy Tests for Meggers[1]

Advantages of Their Use for Measurement of Insulation Resistance Discussed—Practical Methods that May Be Employed for Checking Accuracy of Instruments—Illustrative Examples

By H. B. BROOKS
Chief of Electrical Instrument and Meter Section, Bureau of Standards

IN THE ELECTRICAL WORLD for Feb. 21, 1920, Prof. Richard E. Brown[2] briefly described a method for checking high-range meggers, using relatively low resistances. In the use of this method certain limitations were encountered which are not mentioned in Professor Brown's article. In view of the importance of insulation tests of electrical machines, it was felt that a more detailed treatment, taking these limitations into account, would be of interest to those who have to care for such machines.

The megger-testing set consists essentially of a small hand-driven direct-current generator combined with an ohmmeter having two rigidly connected coil systems free to move in the field of a permanent magnet.[3] The general arrangement is shown in Fig. 1. The moving coil A, which is always in a uniform[4] radial field, receives current from the generator through the resistance coil R' and the unknown resistance X. The direction of this current is such that the coil tends to turn in the clockwise direction. The coils B and B' are connected to the generator through the resistance coil R and tend to turn counter-clockwise to the position in which their rate of cutting the flux is zero, and the torque acting on them is also zero; that is, when the coil B' is in the gap of the annular iron core. This position will be assumed by the coil system when the resistance between the external terminals is infinite; that is, when no current flows through coil A. The corresponding position of the pointer is marked "infinity" on the scale.

The currents are led to and from the moving coils through flexible ligaments of the least possible torsion, so that when the generator is not operated there is virtually no tendency for the moving system to assume any definite position. When the generator is in operation and the resistance between the external terminals is not infinite, the moving system will take up a position where the two opposing torques balance each other. For any given generator voltage, the current in coils B and B' is constant, but their rate of cutting the flux, and therefore their torque, varies greatly with their angular position. On the other hand, the current through coil A varies greatly with change of external resistance, but its rate of cutting the flux is constant for all angular positions. Thus for a given value of the unknown resistance X there is a definite position of the moving element where the torques are balanced.

[1] Published by permission of the Director of the Bureau of Standards of the United States Department of Commerce.

[2] "Checking High-Range Meggers with Low Resistances," ELECTRICAL WORLD, Vol. 75, p. 430, 1920. The figure accompanying this article needs corrections as follows: The terminal marked "ground" should be marked "guard," and it and the "line" terminal should be denoted by some symbol other than the conventional "earth" symbol.

[3] Aside from its smaller size and reduced weight, the "meg" insulation tester differs from a variable-voltage megger essentially in having separate magnetic circuits for the generator and the ohmmeter. The more recent "super-meg" insulation tester has the constant-voltage feature.

[4] This statement applies to the megger as usually described in textbooks and the maker's catalogs. In certain types of meggers, however, this construction is departed from, and the coil A moves from a dense radial field at one end of its travel to a position outside the pole pieces, where it cuts only the leakage flux from them. This modification is made in order to obtain certain desirable scale characteristics and does not affect the general principle of operation as outlined above.

The corresponding position of the pointer is marked on the scale with the value of X. For a given value of X the torques will balance for a definite position of the moving system, even if the voltage supplied by the generator is not constant.

AVOIDING LEAKAGE CURRENT ERRORS

To avoid errors caused by leakage currents within the set the principle of the Price guard wire is used.[5] Fig. 2 shows a diagrammatic plan of the circuits of a three-range megger, including the guard-wire arrangement. The letters have the same significance as in Fig. 1. The upper shaded part of G_1, G_2, G_3 and G_4 represents insulating material supporting the coil or terminal, and the solid black a metal support for the insulating material. In brief, the working of the guard arrangement is as follows: With a high resistance X connected for measurement between the terminals marked "line" and

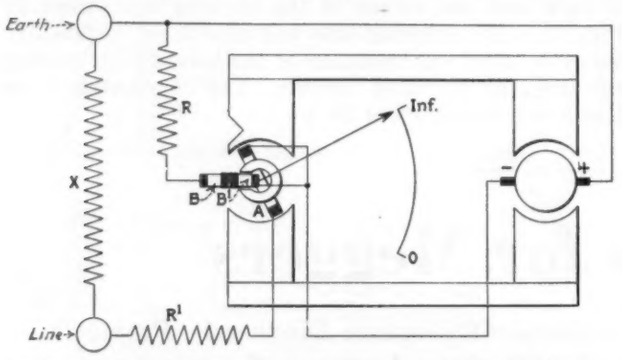


FIG. 1—MAGNETIC CIRCUIT AND ELECTRICAL CONNECTIONS OF A SINGLE-RANGE MEGGER TESTING SET, OMITTING THE GUARD-WIRE ARRANGEMENT

"earth," the generator will maintain the line terminal, the coils R and R', the one-tenth and one-hundredth shunt coils, and the metal parts of the range switch at a potential of 150 volts to 2,500 volts below that of the earth terminal. Since it is not possible to insulate these parts perfectly, in the absence of the guard plates leakage currents would flow to all of them from the parts (for example, the earth terminal and the wire joining it to the + brush of the generator) which are at a higher potential. To take a simple case, assume that X is 1,000 megohms, and that the guard plate G_1 is omitted. A leakage path between the earth and line terminals, such as might occur in humid weather from the deposition of moisture on the wooden case and insulating washers, would be in parallel with X, and if the leakage path has a resistance of say 10,000 megohms, it will cause an error of approximately 10 per cent in the measurement. With G_1 in place, however, a leakage current flowing from the earth terminal is intercepted by the metal part of G_1 and carried to the generator. Its effect is merely to add a negligible amount of load to the generator.

The guard-wire arrangement, while quite old and well known in connection with the measurement of the insulation resistance of cables, is not applied to other electrical measuring apparatus nearly so much as it should be.

The multiple-range feature is obtained by applying shunts to the coil A and its resistor R', the shunts having one-ninth or one-ninety-ninth of their combined resistance, giving ranges of one-tenth and one-hundredth of the unshunted range. The theory of this arrangement has been given by Professor Brown. It may be restated as follows: Let the reading of the megger be X ohms when a resistance of this magnitude is connected to its line and earth terminals, and the range switch is set at "Divide by 1"; that is, with shunt circuit around R' and A open. Then the current through the coil A for a voltage V at the brushes of the generator will be

$$I_a = V/(A + R' + X). \quad (1)$$

Similarly, the current through the other set of coils will be

$$I_b = V/(B + B' + R) \quad (2)$$

where the letters A, B, B', R and R' denote the resistances of the respective coils. The position assumed by the coils, and therefore the reading, depends on the ratio of the two currents, which in this case is

$$I_a/I_b = (B + B' + R)/(A + R' + X). \quad (3)$$

Now, let the range switch be set at "Divide by 10," which shunts $A + R'$ by $(A + R')/9$. This makes the resultant resistance of the shunted coils equal to $(A + R')/10$. At the same time let the external resistance X be reduced to $X/10$. The voltage at the generator terminals in this case having some new value V', we have the new values of current in the coils as follows:

$$I_a' = V'/(0.1A + 0.1R' + 0.1X)$$
$$= 10V'/(A + R' + X).$$
$$I_b' = V'/(B + B' + R).$$

However, only one-tenth of I_a' flows through the coil A, so that the ratio of the currents through the moving coils is

$$0.1I_a'/I_b' = (B + B' + R)/(A + R' + X), \quad (4)$$

which is the same as before; hence the position of the pointer will be unchanged. It will be noted that in each case the result is theoretically independent of the voltage of the generator. The limitations to this statement will be mentioned later.

TESTING HIGH-RANGE MEGGERS

The necessity for some indirect procedure for testing high-range meggers will be apparent when one reflects that they are built to measure up to 10,000 megohms and that even a 10-megohm box is so large and expensive as to be almost a luxury in the average laboratory. While many efforts have been made to develop compact and inexpensive resistors of very high resistance, as by the use of graphite films on ground glass or extremely thin metal deposits on mica, it has been the writer's experience that no such device is sufficiently reliable and constant over a considerable length of time to be used in checking meggers, or in fact for any other purpose where even ordinary accuracy is required.[6]

Taking up the method of making the test in detail, the discussion will first be limited to single-range meggers, in which the shunt coils and range switch shown in Fig. 2 are absent.

The lower part of the scale of a megger of moderate range may usually be checked directly against resistances of known value connected to the line and earth terminals. In addition to precision rheostats, the following apparatus is useful in building up a high resist-

[5] W. A. Price (London) *Electrical Review*, Vol. 37, p. 702, 1895; *Philosophical Magazine*, Vol. 42, p. 150, 1896; Henderson, "Practical Electricity and Magnetism," 1904 edition, p. 75.

[6] A recent remarkable advance in the production of fine metal filaments suggests the possibility of constructing dependable metallic resistors of hundreds of megohms without excessive bulk or cost. See article on "A Method of Drawing Metallic Filaments and a Discussion of Their Properties and Uses," by G. F. Taylor, *Physical Review*, Vol. 23, p. 655, May, 1924. It is stated that metal filaments in glass have been drawn down to a diameter of 0.00001 cm. (0.000004 in.). One filament of antimony had a resistance of 125,000 ohms per centimeter, or nearly 4 megohms per foot.

ance for the purpose: Voltmeters, voltage coils of wattmeters and multipliers for voltmeters and wattmeters. The resistances of these may be measured separately with a Wheatstone bridge, if certified values are not available.

When the scale has been checked directly as far as the maximum available resistance will permit, the resistance between the line and guard terminals should be measured with a bridge, and a resistance of one-ninth of this amount should be connected between these terminals. Since the guard terminal is connected to a point between the coils A and R' and the generator, this external shunt is in parallel with these coils. The effect of this shunting is to reduce the resistance of $A + R'$ to one-tenth of its original value, so that a resistance of X ohms connected to the line and earth terminals should give a reading $10X$ ohms on the megger scale. When the scale has thus been checked up to ten times the maximum available external resistance, the shunt around $A + R'$ should be reduced to one-ninety-ninth of $A + R'$, giving a scale factor of one one-hundredth, and so on until the whole scale has been checked. It is obvious that other shunts may be used, sometimes to advantage; for example, shunts of one-quarter, one-nineteenth, one-forty-ninth of $A + R'$ will give scale factors of one-fifth, one-twentieth, one-fiftieth.

Cases may arise in which one or more high resistances are available none of which has a value corresponding to any marked value on the scale or to any simple submultiple of it. In such a case, if shunts are used giving scale factors of one-half, one-fifth, one-tenth, etc., it will be necessary to interpolate between adjacent division marks on the megger scale. Because the scale law of the megger is not linear, such an interpolation gives at the best only a roughly approximate result, but for practical purposes this may answer, except as the upper end of the scale is approached. The necessity for interpolation may be avoided, in the use of high resistances of odd values, provided there is also available a continuously adjustable rheostat of suitable value for shunting $A + R'$. The resistance X is connected between the line and earth terminals, and the adjustable rheostat between the line and guard terminals. With the generator in operation, this rheostat is adjusted until the index of the megger points to one of the scale values to be checked. The resistance X is by this means made equivalent, for checking purposes, to fX, where f is a multiplying factor, depending on the ratio of $A + R'$ to S, and S denotes the resistance in the shunting rheostat. By analogy with the well-known formula for the use of a shunt with a galvanometer, the value of f is given by the formula

$$f = (S + A + R')/S = 1 + (A + R')/S. \quad (5)$$

The test is then repeated, with S varied until the index of the megger points to the next scale point to be checked, and so on.

Some meggers do not have a guard terminal. In this case a wire may be attached in any convenient manner to the brass disk back of the hard-rubber disk on which the line terminal is mounted. It will be convenient to mount a binding post on the instrument and connect it permanently to this disk, if the instrument seals are not to be broken. Otherwise the connection may be made to the conductor inside the box which runs to the guard disk of the line terminal. It should be noted that the brass disk back of the earth terminal is only a dummy and cannot be used. The guard disk of the "meg" insulation tester is set in a deep groove in the insulating washer supporting the line terminal, and connection may be made to it by winding a fine wire tightly in the groove.

If accurate results are to be obtained in the testing of meggers, certain practical limitations must be respected. In the first place, while theoretically the reading of the megger depends only on the ratio of the two currents in its moving coils, actually there is some friction at the pivots and also a slight torsional control exercised by the thin ligaments which lead the currents to and from these coils. If the moving system is appreciably out of balance and its axis is not exactly vertical, there will also be a slight gravitational torque on the moving system. In order that these disturbing influences may have a negligible effect on the result,

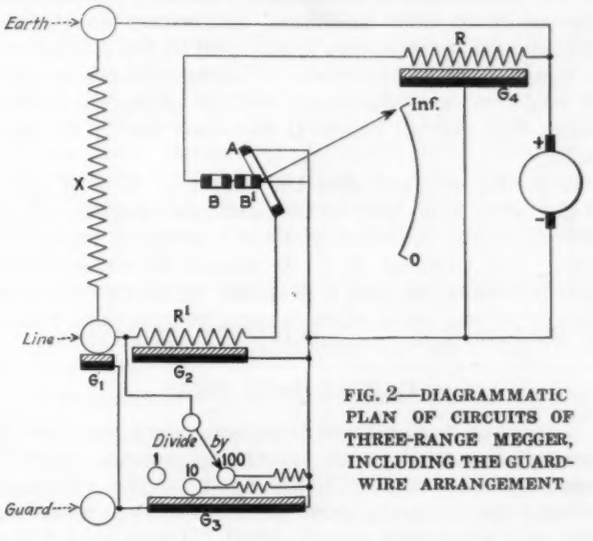


FIG. 2—DIAGRAMMATIC PLAN OF CIRCUITS OF THREE-RANGE MEGGER, INCLUDING THE GUARD-WIRE ARRANGEMENT

the currents in the coils must not be too small. In the second place, the armature of the generator is of relatively high resistance, and hence if we reduce the resistance of the circuit $A + R'$ very greatly by shunting it, and at the same time use a relatively low resistance between the line and earth terminals, we are approaching the condition of short-circuiting the armature and thereby reducing the voltage at the brushes to a very low value. This not only makes it difficult to drive the generator, but reduces the currents in the moving coils to such an extent that the indications will be indefinite for the reasons just stated.

INSULATION OF EXTERNAL RESISTANCES

It is obviously necessary that the external resistances used in checking meggers should be well insulated from each other and from ground. If any doubt exists, the separate rheostats, instruments, multipliers, etc., may be supported on blocks of hard rubber or paraffin. The guard-wire principle could be applied to them, but this will hardly be necessary if the above precaution be taken. The necessity for care in insulating these accessories decreases as their total resistance or the voltage of the megger generator decreases.

In order to determine to what extent the range of meggers may be reduced by shunting, and therefore to what extent high-range meggers may be checked against relatively low resistances, the writer made experiments with three sets of different ranges. The procedures found useful are shown in Tables I, II and III.

Referring to the two tests on the 1,000-volt megger, test A has the advantage that the 10-megohm scale point was checked directly against a known resistance of this value. The accuracy of the results after applying the shunt of 45,500 ohms was substantiated by the fact that the check of the 10-megohm scale point against a known resistance of 1 megohm agreed with the preceding direct check of this point, within the limit of reading. Also, during the course of test A the moving system took up its reading definitely, showing that pivot friction at least was not appreciably affecting the readings. In test B it was not possible to check even the lowest scale point directly and because of the reduced voltage at the generator terminals the moving system did not come to its reading in some cases as definitely as in test A. Nevertheless, the readings in test B agreed with those of test A within the width of the index for scale readings of 10 to 1,000 megohms, and within about twice this amount for readings from 1,000 to 5,000 megohms.

Test A is to be preferred, if known resistances up to 10 megohms are available; but the above comparison shows that for all practical purposes test B is satisfactory.

It should be noted that the values of $A + R'$ given in the tables apply only to the particular meggers tested, and hence the schedule of shunts given is suggestive only. The value of $A + R'$ should be measured for each individual megger and should be divided by 9, 99, etc., to get the value of the shunts to give scale factors of one-tenth, one one-hundredth, etc.

Multiple Range Tests

A megger having more than one range may first be checked directly against known resistances, with the range switch set at "Divide by 1." The resistance between the line and guard terminals is then measured, first with the range switch set at "Divide by 1," then at "Divide by 10"; if the corresponding shunt coil is in correct adjustment, the resistance in the second case will be one-tenth of its value in the first case. If this condition holds within reasonable limits, it is not necessary to use an external shunt; the test may proceed, with the range switch at "Divide by 10," until the maximum available known resistance has been used between the line and earth terminals. Similarly, if the resistance as measured between the line and guard terminals, with the range switch at "Divide by 100," is one one-hundredth of its value with the switch at "Divide by 1," the test may be continued in the same manner.

If the maximum available external resistance is not large enough to check the highest point of the scale, with the range switch set at "Divide by 100," it should be set at "Divide by 1," and an external shunt should be connected across the line and guard terminals to give a scale factor of less than one one-hundredth. In general, the scale factor should not be made any smaller than necessary, although (as the tables show) scale factors as low as one one-thousandth can be used, and in the case of the 1,000-volt megger (test B) the lowest scale factor used was one five-thousandth.

In making the bridge measurements of resistance on the coils $A + R'$, it may be noted that while coil A has a high temperature coefficient, the resistance of R' is so much greater than that of A that the variations will be very small when expressed as a percentage of the total. Moreover, in the use of an external shunt, as described for single-range meggers, the only change of resistance which can affect the results would be a change occurring between the time when the resistance of $A + R'$ is measured and the carrying out of the test of the megger with the external shunt in position.

In emergency tests on meggers, such as might be necessary in the field, the use of a Wheatstone bridge may be dispensed with, if external resistances of a convenient integral ratio are available. For example, suppose that in addition to an adjustable rheostat suitable for use as an external shunt to $A + R'$ there are available rheostats or other apparatus which can be used to obtain the values 1,000, 10,000, 100,000 ohms. These may be used to check the lower part of the scale, if the range is not too great. Noting the reading for 100,000 ohms connected to the line and earth terminals,

TABLE I—MEG INSULATION TESTER

(500 volts, 100 megohms. Resistance of coils, $A + R'$, 100,795 ohms. Values of X used, 10,000 ohms to 100,000 ohms.)

Shunt Used	Scale Points Tested
None	10,000 ohms to 100,000 ohms
11,199 ohms	100,000 ohms to 1 megohm
1,018.1 ohms	1 megohm to 10 megohms
100.9 ohms	10 megohms to 100 megohms

TABLE II—MEGGER TESTING SET

(500 volts, 40 megohms. Resistance of coils, $A + R'$, 201,450 ohms. Values of X used, 5,000 ohms to 100,000 ohms.)

Shunt Used	Scale Points Tested
None	5,000 ohms to 100,000 ohms
22,383 ohms	100,000 ohms to 1 megohm
2,034.8 ohms	1 megohm to 10 megohms
201.6 ohms	10 megohms to 40 megohms

TABLE III—MEGGER TESTING SET

(1,000 volts, 5,000 megohms. Resistance of coils, $A + R'$, 409,500 ohms)

1. Test A: Values of X used, 1 megohm to 10 megohms.

Shunt Used	Scale Points Tested
None	10 megohms
45,500 ohms	10 megohms to 100 megohms
4,136.3 ohms	100 megohms to 1,000 megohms
820.6 ohms	1,000 megohms to 5,000 megohms

2. Test B: Values of X used, 100,000 ohms to 1 megohm.

Shunt Used	Scale Points Tested
45,500 ohms	10 megohms
4,136.3 ohms	10 megohms to 100 megohms
409.9 ohms	100 megohms to 1,000 megohms
81.9 ohms	1,000 megohms to 5,000 megohms

the shunt may be applied and adjusted until the same reading is given for 10,000 ohms. This procedure establishes the value of the shunt for a scale factor of one-tenth, and the scale may be checked up to a reading of 1 megohm. Then the shunt may be readjusted so that with 1,000 ohms connected to the line and earth terminals the reading is the same as for 100,000 ohms before applying a shunt to $A + R'$. This gives a scale factor of one one-hundredth. This method as outlined refers to a single-range megger, but it can obviously be used to check the correctness of the *internal* shunts of multiple-range meggers.

The method discussed in this article may be applied not only to the checking of meggers, but also to provide them on occasion with ranges lower than those built in by the maker. Single-range meggers may have the range reduced to one-tenth, one one-hundredth or one one-thousandth of marked value, and to those already having scale factors of one, one-tenth and one one-hundredth may be given a factor of one one-thousandth if desired. The method is obviously applicable to the test or range alteration of any kind of ohmmeter in which the reading depends only on the ratio of the direct currents in two coils.

Baker River Development of the Puget Sound Company

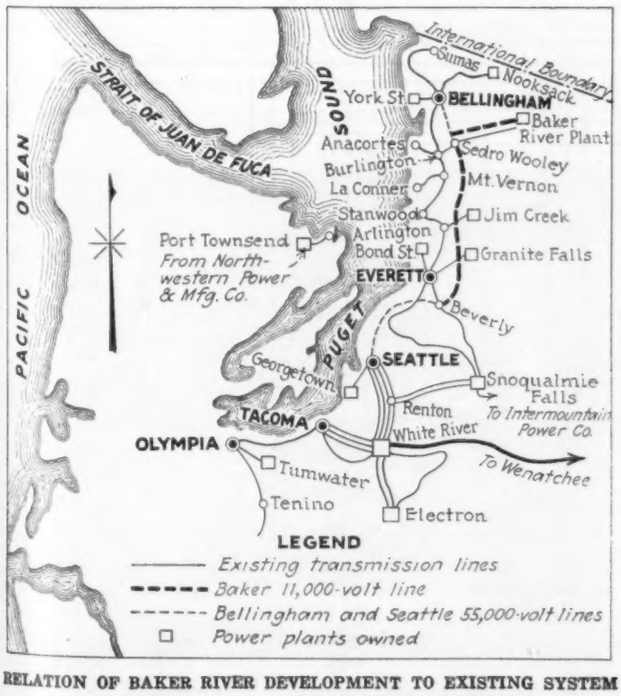
THE most important construction work undertaken by the Puget Sound Power & Light Company within the past few years is the Baker River hydro-electric development, now under construction and scheduled for completion by the fall of 1925. The present development provides for a 250-ft. concrete diversion dam, a concrete-lined tunnel and a power house containing two horizontal double-overhung reaction-type Allis-Chalmers 20,000-hp. turbines operating under a head of 228 ft. and directly connected to two General Electric 19,500-kva. generators.

The Eden power site and all necessary riparian lands were purchased in 1915 and have been held in reserve against the time when the growing market for power would require their development. The demand now exceeds the hydro-electric capacity of the system by such an amount that it is no longer economical to carry the excess with steam power, and the development of a major water power is warranted, The Baker River rises on the slopes of Mount Baker and Mount Shuksan, near the international boundary, and flows south a scant 25 miles to its confluence with the Skagit River at the town of Concrete.

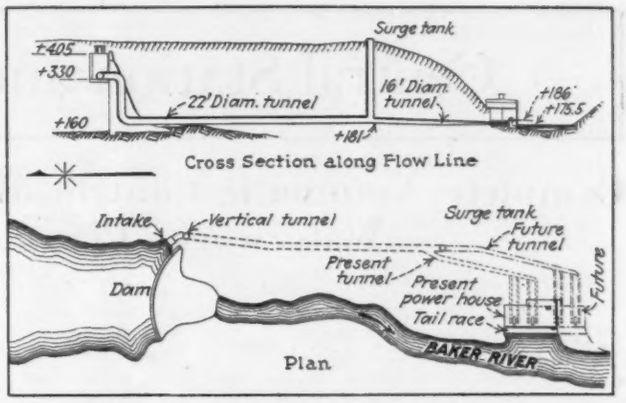
Sixteen hundred feet below the dam will be the power house, where at present two generating units of 20,000 hp. each will be installed. Ultimately two more will be added to make the total capacity 80,000 hp. Water will be led from behind the dam through a 22-ft. concrete-lined tunnel in solid rock to a point just back of the power house, thence through short steel penstocks to the turbines and into the river again.

From the power house the power will be transmitted at 110 kv. 71 miles to a substation on the outskirts of Everett, Wash., where the voltage will be lowered to 55 kv. for use in the Everett district and for transmission over 55-kv. lines to Seattle.

For supplying the Bellingham district a substation similar to the one at Everett, but of less capacity, will be installed at Sedro Woolley, 25 miles from Concrete, and Baker River power will be transmitted at 55 kv. over a new line 25 miles to Bellingham. Power will also be supplied to the existing 55-kv. line, which extends from Bellingham through Sedro Woolley to Concrete, thus giving two lines for supplying the city of Bellingham and making the Baker River power available at all points on the present system in Whatcom and Skagit Counties.



RELATION OF BAKER RIVER DEVELOPMENT TO EXISTING SYSTEM OF PUGET SOUND POWER & LIGHT COMPANY



PLAN AND SECTIONAL VIEWS OF BAKER RIVER HYDRO-ELECTRIC DEVELOPMENT

Letters from Our Readers

Expression for Most Economical Power Factor

To the Editor of the ELECTRICAL WORLD:

From mathematical investigations I have made I have derived a general expression for the most economical power factor, cos θ_e, the tangent of which angle is:

$$\tan \theta_e = \frac{E^2 (pI_S + 8{,}760\, T_L k l)}{2PT_L Mr \times 8{,}760 \times 10^3 k},$$

where

E = receiver-end voltage,
p = cost of condenser equipment per kilovolt-ampere in dollars,
8,760 = number of hours per year,
T_L = time load factor, i.e., that factor or percentage which multiplied by 8,760 gives the total number of hours the constant load P was carried,
l = total condenser losses (100 per cent efficiency),
P = kilowatts,
M = number of miles of line,
r = resistance of conductor per mile,
k = cost per kilowatt-hour delivered in dollars (power-company costs),
I_S = total interest on condenser equipment.

This formula applies so far only to practically constant or base loads and only in cases where the power factor of the line is not dominated by the line characteristics.

Let cos θ_g be the original or given power factor of the system under investigation for power-factor correction.

Then if cos θ_g is less than cos θ_e, there will be an annual loss in the investment; if cos θ_g equals cos θ_e, nothing would be gained by correction, and finally if cos θ_g is greater than cos θ_e, then cos θ_e is the most economical power factor from the standpoint of I^2R losses.

Boston, Mass. GEORGE F. MARSTELLER.

Central Station and Industrial Practice

Complete Automatic Control of Pumps in Waterworks Plant

BY H. S. LANE
Pacific Gas & Electric Company, San Francisco, Cal.

AN INTERESTING application of automatic control for the operation of a waterworks pumping plant in order to do away with the services of an attendant was recently made by a consumer on the lines of the Pacific Gas & Electric Company and is described below.

The plant comprises three direct-connected deep-well turbine pumps with automatic motor starters and constitutes the second of two plants in opposite ends of a city of about 40,000 population. At the first plant are both motor-driven and steam standby units, and operators are continuously on duty. The operation of the second plant is required only when the water demand in its end of town is such that the pressure cannot be maintained from the main station.

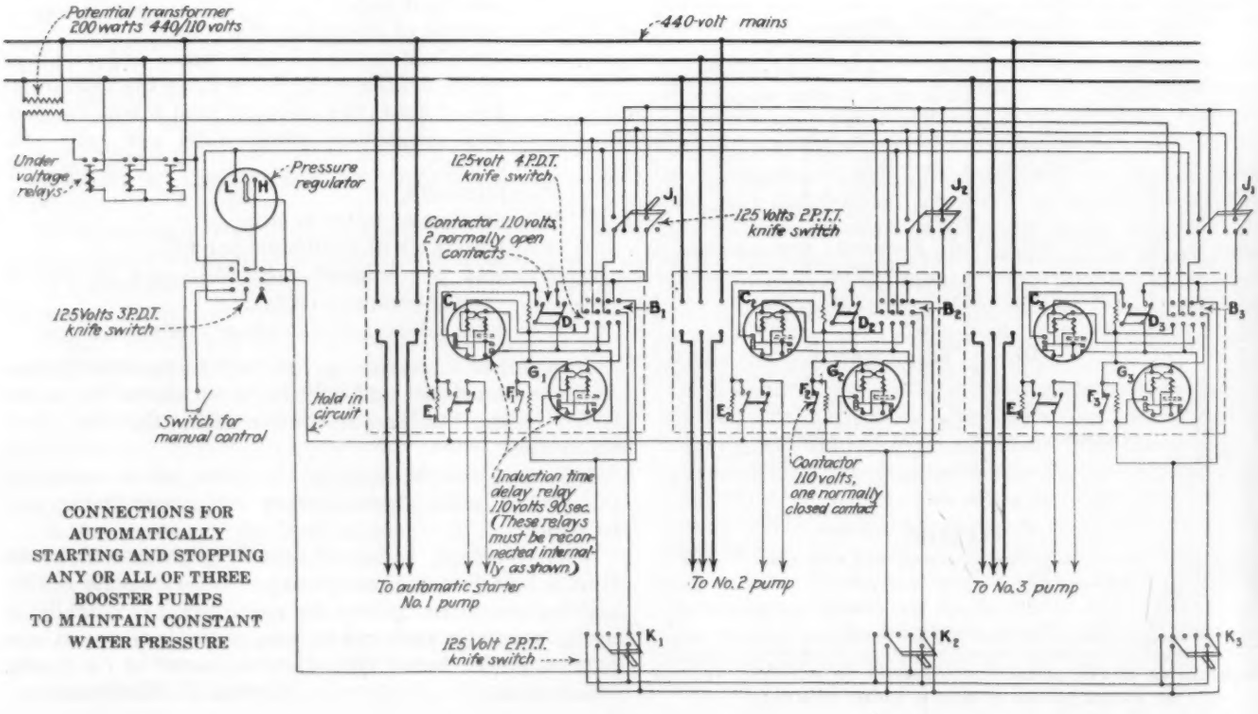
Originally an attendant was employed at this station, who operated one or more of the pumps as the service required. In order to obviate the employment of this attendant, the scheme of automatic control shown in the accompanying diagram of connections was devised. The additional equipment required for automatic control has been installed and in operation for a number of months. The contactors originally installed gave some trouble, but since replacing them with a more rugged type the operation has been entirely satisfactory. The cost of the additional equipment for automatic operation was approximately $500 installed.

The manner in which this equipment functions is as follows:

The low-voltage relays remain closed as long as the supply voltage is normal, but will open and immediately shut down the plant if service fails on one or more phases. Provision is made for operating either automatically by the pressure regulator or manually. With switch *A* thrown to the left, any or all motors as desired are operated manually. With switch *A* to the right, the operation will be controlled by the pressure regulator in the following manner:

The sequence of operation of the three units is determined by the several double-pole, triple-throw switches. For example, if switch J_1 is to the left, J_2 is central and J_3 is to the right, units Nos. 1, 2 and 3 will start up in the order named. If switch K_1 is to the left, K_2 central and K_3 to the right, the units will drop out in the same order. Any other sequence can be set up for starting and drop out independently, thereby making it possible to distribute the work of the station uniformly among the three units. In the following explanation the above order of operation will be assumed:

With switch *B* in the lower position on any panel, that panel and its motor are operative; with switch *B* up, that panel is inoperative and its motor out of service, and the sequence of operations, both starting and drop out, is carried forward to the next succeeding panel. These switches must therefore always be closed in one or the other position. Assume that all switches are in the down position—i.e., all panels cut in. When the pressure falls so that contact is made at *L* on the pressure governor, the coil on time-delay *C* on panel No. 1 raises the armature, thereby closing contact No. 1 (contact No. 2 remains closed) and starts the relay timing motor. After the


Potential transformer 200 watts 440/110 volts
440-volt mains
Under voltage relays
Pressure regulator
125-volt 4 P.D.T. knife switch
Contactor 110 volts 2 normally open contacts
125 Volts 2 P.T.T. knife switch
125 Volts 3 P.D.T. knife switch
Switch for manual control
Hold in circuit
Induction time delay relay 110 volts 90 sec. (These relays must be reconnected internally as shown)
Contactor 110 volts, one normally closed contact
To automatic starter No. 1 pump
To No. 2 pump
To No. 3 pump
125 Volt 2 P.T.T. knife switch

CONNECTIONS FOR AUTOMATICALLY STARTING AND STOPPING ANY OR ALL OF THREE BOOSTER PUMPS TO MAINTAIN CONSTANT WATER PRESSURE

predetermined time for which this is set the element trips the latch, opening contact No. 2, thereby disconnecting the timing motor and closing contact No. 3, which energizes contactor D_1.

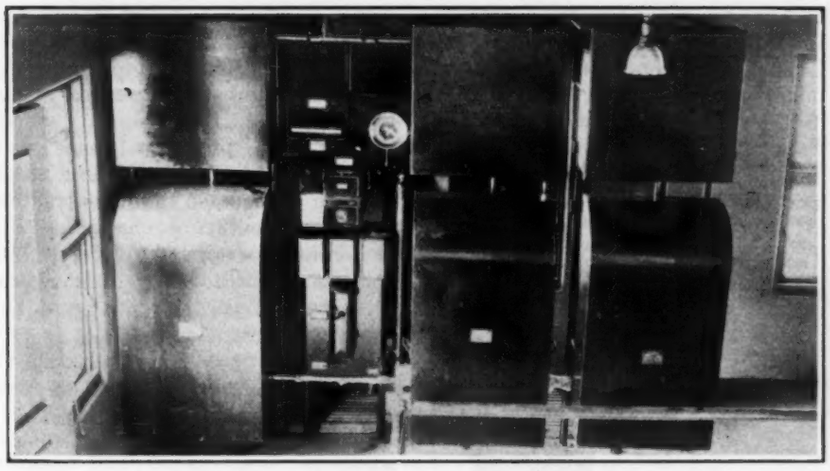
The closing of D_1 energizes E_1 (through normally closed contactor F_1), thereby closing the pilot circuit of the motor starter and starting No. 1 motor. One contact on E_1 comprises its holding circuit so that it will stay in until released as explained hereafter.

The closing of contactor D_1 also energizes relay C_2 on panel No. 2, thereby starting the same sequence of events on this panel. Now, if the operation of No. 1 pump is sufficient to raise the pressure and open contact L before the time latch on relay C_2 operates, then C_2, D_1 and hence C_2 will drop out, leaving only motor No. 1 operating. If, however, No. 1 pump, either at this moment or subsequently, cannot sustain the pressure, then No. 2 pump will be started, and ultimately, if required, No. 3 pump will in like manner come on.

Assume now that all three pumps are operating. When the pressure rises so that contact is made at H on the pressure governor, then time-delay relay G_1 on panel No. 1 will be energized. When this pressure has persisted for the time for which the relay is set, contact No. 3 will close (and contact No. 2 open), thereby energizing contactor F_1, opening the closing circuit of E_1 and thereby shutting down motor No. 1.

The closing of contact No. 3 on relay G_1 at the same time energizes relay G_2 on panel No. 2. Obviously, if shutting down motor No. 1 drops the pressure sufficiently to open contact H on the governor, contactors G_1 and G_2 will drop and No. 2 and No. 3 motors will continue to operate. If, however, at this moment or subsequently, the pressure remains high enough to keep H closed, then No. 2 pump will shut down, and ultimately No. 3 will drop out.

The time-delay relays will prevent starting or stopping the motors by momentary fluctuations of pressure. However, they must be set to operate in the least practicable time, considering the starting characteristics of the motors. The contacts on the pressure governor must be such as to prevent the possibility of overtraveling before all three relays, for either starting or stopping, can function in sequence.



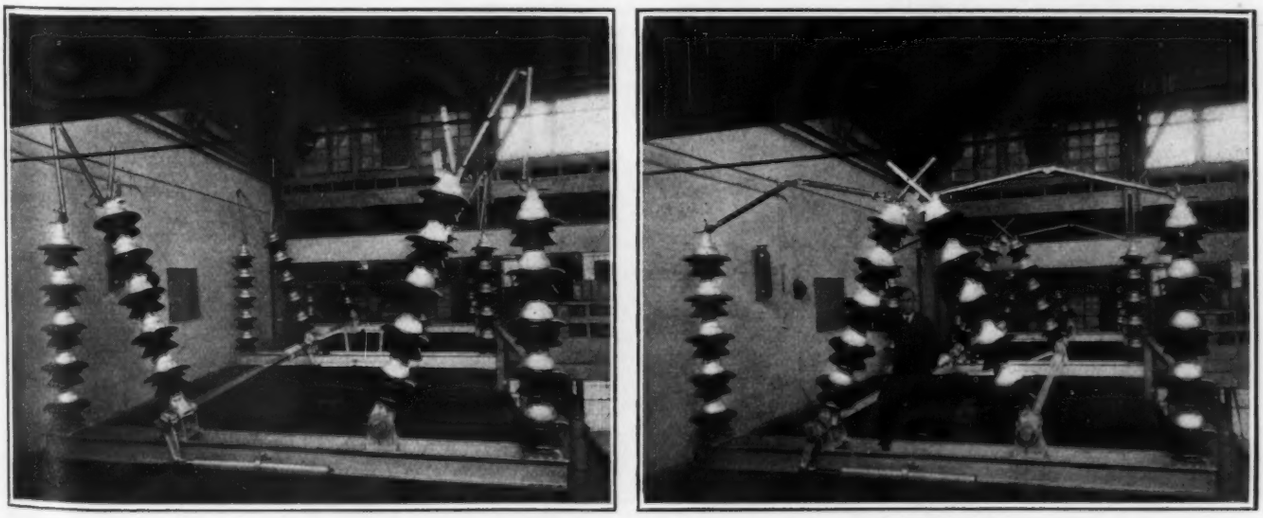
RELAY PANELS AND AUTOMATIC STARTERS FOR PUMPING PLANT

New Type of High-Voltage Switch

Construction Details and Tests of 220-Kv. Motor Operated Disconnecting Switch—Counter-Balancing Springs for Insulator Stocks Important Design Feature

AN INTERESTING test of a new type of 220-kv. disconnecting switch has recently been made by the Electric Power & Equipment Corporation of Philadelphia, its designer. The switch was developed for possible use on the 220,000-volt transmission lines that various utilities are contemplating building in the East and is one of the largest air-break switches ever built. The test was witnessed by representatives of several utility companies interested.

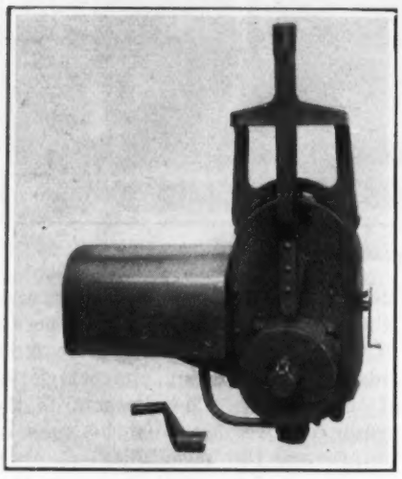
Beginning at midnight of March 18 the switch was in continuous operation for thirty-four hours and twenty minutes, during which time it was opened and closed 3,420 times, a rate of 100 complete cycles an hour.



SWITCH FOR 220-VOLT SERVICE IN OPENED AND CLOSED POSITIONS

At the end of the test the switch was in excellent condition, no parts had broken, and none gave signs of unusual wear.

The switch, which weighs 9,850 lb. complete, rests on three 8-in. channel-irons, one for each phase. There are twelve five-unit sets of Locke



MOTOR-OPERATING GEAR FOR HIGH-VOLTAGE SWITCH

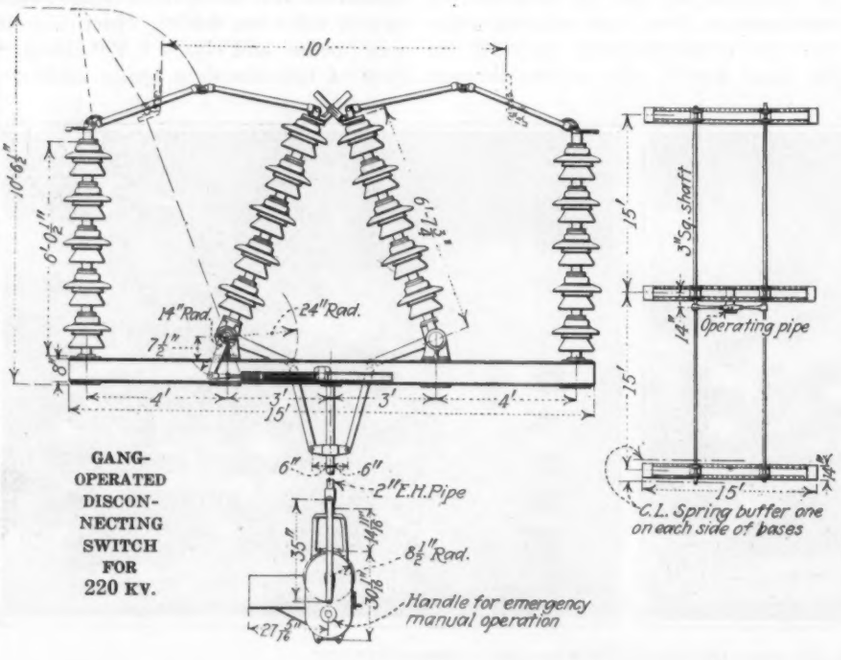
type 7,785 17-in. pedestal insulators with a combined weight of 4,500 lb. The dry-arc overvoltage of the insulators is 556,000 volts and the wet-arc overvoltage is 452,000 volts.

The moving connecting cables are carried through 2-in. brass tubing with movable joints of cast bronze. The tube section is of unusually large diameter to help eliminate corona trouble and losses. There is a distance of 10 ft. between switch points in the open position. When closed a phosphor spring bronze double contact closes over a cast-brass contact, which is made unusually heavy for mechanical reasons rather than from a carrying-capacity standpoint. The phosphor-bronze contacts are made unusually long to allow for expansion and contraction due to temperature changes. The switch is not designed to break a line load, so 18-in. horns of ⅜-in. diameter brass are provided to break the charging current only.

The three phases are spaced 15 ft. apart and are operated by two cast-steel shafts, 3 in. square. These shafts are moved by a 1-hp. motor, which is connected to them through a motor gear, a vertical operating rod with a 14-in. stroke, a crosshead on the rod, two movable links and two 24-in. crank-arms.

Each stack of insulators is individually counterbalanced by incased oil-tempered coil springs, which have a pressure of 750 lb. compressed. There is a total of twelve springs, four to each phase. When the switch is either open or closed six springs are compressed and six free and when the switch is in a neutral position all the springs are free.

The motor-operating switch gear has a 12-in. crank throw and is equipped with a precision stop to prevent any overtravel of the switch and with an automatic clutch to release the motor for manual operation of the gear. Under ordinary conditions 80 per cent of the motor's power is used to operate the switch, which can also be opened or closed easily by hand.



GANG-OPERATED DISCONNECTING SWITCH FOR 220 KV.

Cost of High-Tension Energy at Boston

FROM an analysis of the costs of producing, transmitting and delivering high-tension energy to substation buses on the system of the Edison Electric Illuminating Company of Boston, Mass., during 1924, given herewith, it appears that the average direct cost for energy delivered was 1.297 cents per kilowatt-hour at the substation bus. The average revenue from high-tension sales (electricity in bulk, not distributed at retail) was 1.409 cents per kilowatt-hour, leaving a balance of 0.112 cent per kilowatt-hour for commercial, new business, general and miscellaneous expenses incident to production and transmission.

COSTS OF PRODUCING, TRANSMITTING AND DELIVERING ENERGY IN BOSTON DURING 1924

General Data:	
Investment data as of June 30, 1924 (assumed average for year):	
Production investment, L. St. plant	$18,309,792
Transmission lines, switches and meters	9,000,000
Total investment, excluding Weymouth plant, under construction	84,792,099
Cost data for year ended Dec. 31, 1924:	
Production expenses at L. St., including purchased energy	3,183,767
Fixed costs: Taxes, interest, dividends and balance for reserves	10,206,144
Ratios of investments:	
Production investment, per cent of total investment	21.6
Transmission investment, per cent of total investment	16.6

COST ON SWITCHBOARD AT GENERATING STATION

		Average Cost per Kw.-Hr.* Mills
Operation and maintenance expenses for high-tension production and cost of energy purchased	$3,184,000	6.03
Fixed costs, 21.6 per cent of $10,206,000	2,205,000	4.18
Total direct cost on switchboard	$5,389,000	10.21

High-tension output, 527,569,000 kw.-hr.

*Station output.

COST DELIVERED AT SUBSTATION

		Average Cost per Kw.-Hr. Mills
Production cost, from above	$5,389,000	10.56
Transmission:		
Operation and maintenance (estimated)	150,000	0.29
Fixed costs, 10.6 per cent of $10,206,000	1,080,000	2.11
Total direct cost at substations	$6,619,000	12.97

Transmission line output, 510,687,000 kw.-hr.

Comparison of average revenue from high-tension sales with average direct cost of energy delivered at substations.

	Mills
Average revenue from high-tension sales	13.9
Corrected for customer paying on unexpired contract	14.09
Average direct cost of energy delivered	12.97
Balance available for commercial, new business, general and miscellaneous expenses incident to production and transmission of energy	1.12
Equivalent to, in money available for these overhead expenses if all energy were delivered and sold at high-tension, 510,687,000×1.12 mills	$572,000

Farm-Line Extensions

Group Delivery of Power to Farmers Most Economical Method—Use of Iron Wire Favored—Suitability of Several Systems Discussed

BY CHARLES M. WELCH
Ogden, Ark.

SUPPLYING electricity for light and power to the farm involves consideration of the investment charges, continuity of service, reasonableness of rates and profits derived. If a farm uses only 5 kw. per month, amounting to $0.75, and the company supplying the electricity is compelled to produce 20 kw. more in making delivery of the relatively small amount of energy used, or if the farmer builds the line and the income is not enough for the proper maintenance of the service, it is obvious that the plan of delivery lacks the proper elements of profitable merchandising.

Better results may be obtained by making delivery to groups of farmers along a given branch or sector of primary line. In such a plan of group delivery only one meter is required to check the primary delivery to the group, and for this flat rates may be allotted to the individuals composing the group, under provision for adjustment by rebate for economical use of energy or further payments prorated in proportion to the allotted flat rates that are in use.

By this method a proper proportion of the transmission loss is borne by the consumer, and, moreover, the group may be required to guarantee all payments. Also, the primary-delivery group meter may be read at longer intervals than once a month and the cost of meter reading and collecting in country districts will be greatly reduced. Whatever the means of financing a group of farm-line extension, whether by contributions by the farmers or by the company assuming the entire cost, the plan of group delivery has much to commend it.

But the high cost of investment in the line has created inertia and indifference in central-station companies and held back the development of the farm-line extension. The farmer's demand for electricity on the farm has consequently been seriously neglected.

A material saving is effected by the use of iron-wire lines in cases where the amount of electricity furnished is relatively small and the distance is not too great or where the possibility of greatly increased future load hardly justifies a more expensive copper line.

Iron wire for small transmission lines has been used with marked success in a great many instances extending over several years. The great strength of iron wire allows considerable saving in poles, crossarms and insulators. In iron-wire calculations the greatest conductivity for transmission work is found with average iron telegraph wire. In inland districts with pure country air iron wire with a good coating of galvanizing has been known to last thirty years, a fair average life under ideal conditions being about twenty years.

A table giving the capacity, spacing and voltage for different sizes of galvanized-iron telegraph wire suspended outdoors is printed on page 982. The kilowatt-miles are based on one-half mile of line with two wires. To find the load in kilowatts which can be transmitted with 10 per cent drop with a given voltage to neutral and for any system, divide the kilowatt-miles given in this table by the length of transmission line (distance in miles between supply and receiving points) and multiply the product by the following factors:

	Constant
Two-wire, single-phase	0.50
Three-wire, single-phase	2.00
Four-wire, two-phase	1.00
Four-wire, three-phase	1.50
Three-wire, three-phase (delta)	0.865

As an example of the use of iron wire, it is obvious by reference to the table that a four-wire, three-phase, 22,500-volt system will trans-

Instrument Connections Made Convenient

BY J. R. HALLADAY
Meter Relay Engineer, Warren Division, Ohio Public Service Company

TO FACILITATE the installation of portable graphic instruments, a connection board shown in the accompanying illustration was developed by the meter department of the Warren division of the Ohio Public Service Company.

The relative location of the plug receptacles on the panel is the same as that of the terminals on the instrument, which makes it very easy to connect the instrument in the circuit. A test block is provided to permit changing connections without interfering with the service meter. This scheme makes possible the installation of graphic instruments with a minimum loss of registration. The board measures about 18x24x¼ in., is made of Bakelite and has folding legs.

BOARD FOR PORTABLE GRAPHIC INSTRUMENTS

mit 100 kw. a distance of 32.25 miles over four No. 6 iron wires with 10 per cent drop. With a grounded neutral in the four-wire system the maximum potential to ground is only 13,000 volts. Thus moderate-strength insulators can be used, and 13,000-volt branch single-phase lines may be run off at intervals for serving small groups in remote communities. For the branch lines light poles can be used with the neutral wire stapled to the top of the poles and grounded each mile for lightning protection. The remaining No. 6 iron wire can be inexpensively and safely carried on an approved iron bracket spiked to the pole and the necessary 13,000-volt insulator fitted and tied to the line wire, requiring only one insulator and bracket to each pole. For the larger groups small outdoor transformer substations may be employed to provide 2,200-volt primary delivery, but 13,000-volt distributing transformers connected single-phase to the main and neutral may also be used for supplying country users.

By further reference to the table it is apparent that 25 kw. may be transmitted a distance of 15.2 miles with 10 per cent drop on a two-wire, 13,000-volt single-phase system using two No. 6 iron wires, so that ample capacity is available in most cases for the small groups located at a distance from the main four-wire, three-phase transmission line.

It should be noted that with a grounded neutral Y system a ground of a phase wire is a short circuit of the transformer on the grounded branch, and the transmission becomes inoperative; therefore, 13,000-volt expulsion-type cut-outs must be connected where the branch circuits take off from the main lines, which will save shutdown of the main line when temporary grounds occur on any branch. Moreover the main line should be constructed with great care in the matter of keeping free from trees. It is considered from the view of safety to life and prevention of fires that grounded Y systems are very desirable, especially so if the secondary system is also grounded. As the code now requires grounding of all secondary systems, no further criticism of the grounded Y system is important regarding these points.

It is necessary to point out that no combination of star-to-star-connected transformers whatever should be used. In making transformer connections on three-phase lines the best authorities recommend that only delta-to-star connection be used for stepping up the voltage from the generator to a grounded neutral Y system. If these instructions are followed, no trouble will occur from disturbing harmonic conditions.

CAPACITY, SPACING AND VOLTAGE FOR DIFFERENT SIZES OF GALVANIZED IRON TELEGRAPH WIRE SUSPENDED OUTDOORS

Capacity in kilowatt-miles with 10 per cent voltage drop at 60 cycles

Size of Iron Wire (B.W.G.)	Voltage and Spacing 2,200, 12-In.	6,600, 18-In.	13,200, 24-In.	22,500, 36-In.	33,000, 42-In.
0	28.0	250	1,000	2,770	6,200
1	26.0	235	925	2,630	5,800
2	25.5	227	900	2,540	5,700
3	25.0	225	895	2,520	5,600
4	24.5	220	864	2,440	5,430
5	23.0	205	810	2,260	5,100
6	21.5	200	760	2,150	4,600
7	18.5	165	655	1,830	4,100
8	17.0	150	600	1,700	3,820
9	15.0	135	535	1,500	3,400
10	13.0	116	488	1,290	2,900
11	12.5	111	437	1,230	2,780
12	10.5	90	355	1,000	2,250

Instability of the neutral by unbalancing the circuits is taken care of by grounding the neutral. The more often the neutral is grounded the better. Carrying the neutral iron wire stapled along the pole tops along the main and branch lines, and grounding the neutral each mile, will better balance the system and will also provide the very best lightning protection.

The cost and losses of large transformers are often too high compared with the revenue from the load to be served. On farm-line extensions and in isolated districts much money is being wasted in providing improper equipment. Simple and inexpensive transformer equipment gives the best results. Apparently a demand exists for smaller and cheaper transformers for this work. In this connection the independent transformer companies have recently developed new designs in farm extension service transformers, and these new transformers are valuable contributions in helping solve the problem of profitable and satisfactory delivery of electricity on the farm.

Contact Length of Clamped Tube Joints

IN ANY construction work involving the carrying of current in iron, copper, aluminum or brass tubing the Utica Gas & Electric Company has found the accompanying table to be very valuable. The company compiled the table from Kent's "Mechanical Engineer Pocket Book," data from the General Electric Company and data from their own records.

The dimensions and rating of tubing with the minimum length of contact for a clamp joint are given. In working out the figures the resistance of iron was taken as seven times copper, resistance of aluminum as 1.66 times copper and the resistance of brass (composition, 65.8 per cent copper and 34.2 per cent zinc) as four times copper. The inside and outside diameter of tubing, sectional area, maximum carrying capacity and minimum length of contact are included.

DIMENSIONS AND RATING OF TUBING WITH CONTACT LENGTHS FOR CLAMP JOINTS

Iron Pipe		Standard Iron Pipe Size								Extra Heavy Iron Pipe Size						
				Galv. Iron	Copper		Aluminum		Brass			Copper		Aluminum		Brass
Nominal Size of Pipe, In.	Outside Diameter, In.	Inside Diameter, In.	Sectional Area of Metal, Sq.In.	Maximum Carrying Capacity, Amp.	Maximum Carrying Capacity, Amp.	Minimum Length of Contact, In.—Bolted Contact	Maximum Carrying Capacity, Amp.	Minimum Length of Contact, In.—Bolted Contact	Maximum Carrying Capacity, Amp.	Minimum Length of Contact, In.—Bolted Contact	Inside Diameter, In.	Sectional Area of Metal, Sq.In.	Maximum Carrying Capacity, Amp.	Minimum Length of Contact, In.—Bolted Contact	Maximum Carrying Capacity, Amp.	Minimum Length of Contact, In.—Bolted Contact	Maximum Carrying Capacity, Amp.	Minimum Length of Contact, In.—Bolted Contact
⅛	0.675	0.493	0.167	...	300	¾	231	½	150	½	0.421	0.219	350	1⅛	265	½	175	¾
¼	0.840	0.622	0.250	...	400	¾	308	½	200	½	0.542	0.323	460	1	350	½	230	¾
⅜	1.050	0.824	0.333	...	475	⅞	366	½	238	½	0.736	0.441	550	1⅛	425	½	275	¾
1	1.315	1.049	0.494	150	600	⅞	462	½	300	½	0.951	0.648	695	1⅛	535	1	350	¾
1¼	1.660	1.380	0.668	200	750	1	577	½	375	½	1.272	0.894	880	1⅛	670	1	440	¾
1½	1.900	1.610	0.799	225	850	1⅛	654	½	425	½	1.494	1.083	1,000	1⅛	770	1	500	¾
2	2.375	2.067	1.074	275	1,050	1⅛	809	½	525	½	1.933	1.497	1,250	1⅛	965	1⅛	625	¾
2½	2.875	2.469	1.704	350	1,400	2⅛	1,078	1⅛	700	¾	2.315	2.275	1,610	2⅛	1,280	1⅜	820	¾
3	3.500	3.068	2.228	...	1,924	2⅜	1,482	1⅛	962	¾	2.892	3.055	2,280	2⅛	1,760	1⅜	1,140	1
3½	4.000	3.548	2.679	...	2,210	2⅜	1,702	1⅛	1,105	¾	3.358	3.714	2,630	2⅛	2,050	2⅛	1,310	1⅛
4	4.500	4.026	3.174	...	2 520	2⅜	1,940	2⅛	1,260	1	3.818	4.461	3,000	3	2,320	2⅛	1,510	1⅛

Commercial Activities and Public Relations

Advantages of Limiting Merchandise Lines

Efforts Confined to Only a Few Makes of a Given Appliance Maintain More Satisfactory Sales Volume at Reduced Selling Expense

BY C. A. NASH
Sales Manager United Light & Power Company, Davenport, Iowa

PERHAPS more appliances would be sold if a store carried every available make of a given type. On the other hand, limitation in the number of makes of a given type of appliance has many advantages. Considering electric washers, for example, the saving in space in storeroom, salesroom and display windows is tremendous if severe limitation in number of makes of machines is practiced. The display of many machines of the same make is, when practiced occasionally, more effective than the display of a motley variety of machines all intended to do the same kind of service.

Much less of the salesman's time is required to show and sell a single make of machine than when the customer is allowed to choose between a number of makes equally good. One store canot sell all the appliances in a community, and it will have a lower sales expense if efforts are confined to simplified lines. Moreover, the appliance will be better sold if the salesman is not obliged to familiarize himself with a half-dozen different appliances of the same kind.

BETTER SUPPORT FROM THE MANUFACTURER

It is reasonable to believe that better support will be obtained from the manufacturer if a store confines its efforts to the lines of one or two makes. It takes the heart out of a manufacturer's representative to find a different competitor's appliance on display each time he calls to offer his services. The most effective help manufacturers can give is in selling the idea behind an appliance through national advertising and assisting in special campaigns.

Constant publicity and effort devoted to a single make of appliance gradually breaks down resistance to sales and makes it easier to sell the appliance in that community. The cumulative effort of publicity and the powerful effect of wide use of a certain make of appliance in a given community are a valuable aid to sales. The sale by this company in only three communities of 1,200 electric washers in one year could not have been accomplished had sales effort been divided among several makes of machines.

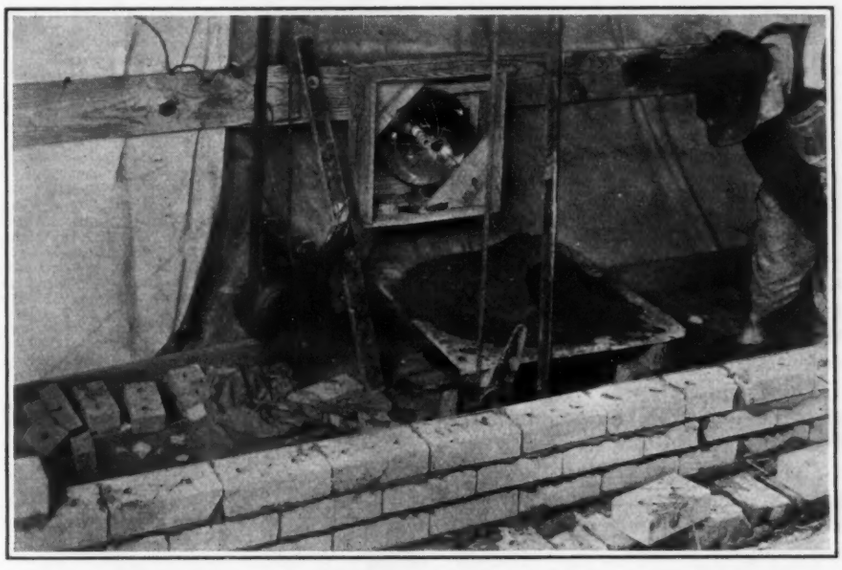
Need for home demonstrations prior to sale is becoming less and must become less if a fair profit on appliance sales is to be realized. The wide sale of a single make of appliance in a given community makes the demand for home demonstrations diminish as the number of sales increases.

A large volume of sales is desired by every merchandiser, but larger profits can be realized only when the sales expense does not increase as rapidly as the sales volume. When carrying a multiplicity of lines, the sales expense for each make of appliance may be about the same. If an equal volume of sales is obtained with a single line, the sales expense will be lower and the profits larger. It takes courage to resist the temptation to take on many lines of appliances offered by the zealous representatives of manufacturers, but courage here will be well repaid. Fewer victims of high-pressure sales methods among central-station merchandisers will mean greater merchandising profit and more stable markets for the manufacturers. The appliance sales manager in buying his stocks must learn to say "no," pleasantly, of course, but at the same time firmly.

Electric Heat and Bricklaying

BY SHELDON F. MYERS
Westinghouse Electric & Manufacturing Company

A PRACTICAL application of electric heat to bricklaying occurred last winter in the construction of the Parke Apartments in Buffalo, N. Y. With the temperature hovering a little above the zero mark something had to be done to keep mortar from freezing. The usual coal-fired heat-making equipment was inefficient and too often drew the workmen away from their jobs to warm their hands and feet. Already pressed to meet a completion date, the contractor saw that he would have to resort to some other method and with no loss of time.



REFLECTOR-TYPE ELECTRIC HEATER MOUNTED ON GUARD RAIL OF SCAFFOLD

An electric heat salesman, hearing of the contractor's difficulties, suggested a battery of Westinghouse "Cozy Glow" heaters, which consist

of the conventional heating element and a bowl-shaped reflector. The contractor was persuaded to install thirty-six of these devices, and they proved to be just the thing needed. A shaft of heat was thrown directly upon the work all the time and prevented freezing of the mortar. The workmen also benefited from the warmth radiated in the working area. The heaters were placed in wooden boxes, and thus they could be moved from place to place without trouble and were safe from damage. A hanger was put on the back of each box, and as the work progressed the bricklayer could take the heater along and hang it up on the guard board of the scaffold.

Compared with the old-fashioned furnace or "salamander," electric heat was found much cheaper. The services of the man required to keep the furnace in operation were rendered unnecessary, and the bills for energy were less than his wages had been. The cost of installation was also comparatively small, the electric heaters costing much less than the former equipment.

Profitable Tri-Partnership Sells Electric Glue-Pots

A STRIKING instance of how successful sales campaigns can be made through the co-operation of a central station, a manufacturer and a jobber of electrical appliances is revealed in the record of more than thirty sales of electric glue-pots recently reported in Boston.

This campaign was originated by the Edison Electric Illuminating Company of Boston as a step in a systematic plan to locate new customers whose electric heating load would be a considerable addition to the company's lines.

To put the selling campaign on a systematic basis, an investigation was first made by the Edison company covering the industrial uses of hot glue in connection with manufacturing processes in Boston.

The next step was the selection of such glue-pots already on the market as would meet the specifications devised. Several of these were chosen and their manufacturers notified of the desire of the central station to enter into a co-operative plan for selling. The manufacturers in turn notified their jobbers and thus a virtual tri-partnership for selling was formed.

Obviously, to make calls on the large number of users of hot glue would be a colossal undertaking, so it was decided first to classify the users of glue according to the processes of manufacture. Seventy-one firms were found that used hot glue, melted paraffine or melted compounds in some process or other; 215 firms used hot glue in some particular kind of work; and forty-five other firms were found to have use for electric heating pots in their establishments. Lists of these firms and their addresses were given to the manufacturers and jobbers, who then took the next step, that of circularization.

The circularization was carefully planned. In a first letter to the "prospect" the average annual cost of operation of an electric glue-pot was set forth, the time saving through the use of electricity and the price of new pots of various capacities also being included. After two weeks a second letter followed. In this, additional information concerning the saving of costs was cited—for example, the reduction in insurance premiums and the saving of labor charges through the added convenience of the electric type of pot.

In most cases a third follow-up letter was deemed advisable. This named specific installations in Boston and cited unquestionable advantages in the use of electric glue-pots. In all cases the letters were sent out at two-week intervals through the offices of either the manufacturer or the jobber. That this co-operative plan was both practicable and profitable is shown in the results obtained from one co-operative alliance consisting of the Edison Electric Illuminating Company, the Westinghouse Electric & Manufacturing Company, and the Chandler & Farquhar Company, the latter an electrical jobber.

Thirty glue-pots of the Westinghouse type ranging in rating from 57 to 195 watts were sold through a circularization of a carefully selected list of prospective customers. This volume is ten times the return obtained through a random circularization promoted about a year ago on the same appliance. In addition, from the information broadcast, it is probable that a further increase in sales will result in the near future.

First Letter

Dear Sir—Seven to twelve dollars is the average annual operating cost of an electric glue-pot. This low operating cost, however, is not the most important feature of the Westinghouse electric glue-pot. It is compact, you can put it right on the work bench where the glue is being used and the rheostatic control enables you to keep the glue at the best working temperature at all times. These are the vital considerations.

You can readily understand the time saving over the old steam-heating method; the carrying of the pot back and forth, the drying up of the glue and all of the delays due to this old method. It is logical to expect better workmanship when the artisan is equipped with this convenient glue-pot, which enables him to give more expert attention to his work.

Fifteen dollars for the pint size and $17 for the quart size are the prices of two convenient sizes to try out. Give your workers individual glue-pots and watch the increase in output. Return the inclosed card to try one out.

Yours very truly,

Second Letter

Dear Sir—An insurance broker cites a case of a concern that saved $1,470 through substituting an electric glue-pot for the dangerous gas-heated type.

Insurance premium is only one of the reductions to be gained with a Westinghouse rheostat controlled glue-pot. Time, spoilage and space are saved with this compact little glue-pot. It can be attached to the light socket and the multiple heats keep the glue in the right condition at all times.

Westinghouse glue-pots are made in four sizes, one pint, and two, three and four quarts. They occupy little room and enable the worker to increase the quantity and quality of his output.

Why not try the electric glue-pot? It should be highly profitable. Return the inclosed card to order or to have more information supplied you.

Very truly yours,

Sales Department.

Third Letter

Dear Sir—Many concerns around Boston have turned to the electric glue-pot where their processes require heated glue.

One woodworking concern recently installed several electric heaters for drying its wood and several Westinghouse glue-pots with rheostats, which permit bringing the glue quickly to the desired temperament, then holding it there on a lower heat.

With the Westinghouse glue-pot time is saved in trips to a central heater. Where jobs are scattered over a work room the electric glue-pot can be conveniently attached to a nearby lamp socket. Electricity is the safest method of heating glue and many times means a saving in insurance rates.

You will do well to try out a Westinghouse glue-pot. Its cost is slight and the advantages to be gained are many.

Very truly yours,

Heating Section,
Industrial Division.

Public Relations as a Preventive Medicine

CENTRAL-STATION commercial departments in their sales contacts with customers of utility companies have the greatest opportunity for impressing upon the public the value of the service which they have to offer and thereby building better customer and public relations. The importance of the work of the sales department was illustrated in an unusual manner by H. T. Sands, vice-president Charles H. Tenney & Company, Boston, at a recent sales conference of that organization, as follows:

"About two years ago several leading newspapers of the country published a contract which Samuel Vauclain of Philadelphia had made with his physician. Briefly, this provided that for a certain sum per year the physician undertook to keep Mr.

Vauclain in good health and also agreed to forfeit a very considerable sum for each day that he was unable to attend to business because of illness. Mr. Vauclain believes in paying money for preventive rather than curative medicine. To my mind public relations is the preventive medicine of our industry, which, if properly used, will keep our industry in a sound and healthy condition.

"Now, I imagine some of you think that the developing of public relations is a matter for the executive and is no concern of the commercial department. I believe there is no part of our business which affords a greater opportunity for the building of right public relations than the commercial department.

"You are very fortunate in being employed by companies whose policy is to put into the hands of their customers the very best possible devices procurable for the utilization of our service. You men and women here are coming directly in contact with the public. In very many cases to the customer you will be the company, and the company will be judged by the attitude which you take toward your customer. What we are striving for in our public relations work is a larger measure and a better understanding between the public and ourselves. That public intends to be fair, but how in the world can the public be fair unless it can act intelligently? And how can it act intelligently unless it is in possession of the facts? And to whom else should it look for the facts but to us? We have a wonderful story to tell—a story that we all should be proud to tell—and I know of no branch of our business where the opportunity for telling the story not merely in words, but the spirit of real service, is greater than in the commercial department."

Kitchen Units Sold to 16.4 per Cent of Customers

THE Idaho Power Company, Boise, Idaho, closed a thirty-day kitchen-lighting unit campaign with the sale of 3,400 units, each of which, it is estimated, will add 50 kw.-hr. to each residential customer's annual consumption. A bogie was set at 2,200 units, based on 10 per cent of the total number of residential customers served. This was exceeded by more than 50 per cent, as the campaign closed with sales equal to 16.4 per cent of such customers.

Two Companies Compete in Safety Contest

By J. E. JORDAN
Superintendent of Distribution, El Paso Electric Railway Company, El Paso, Tex.

THE value of safety contests is demonstrated by the curves reproduced in Fig. 1, which show the number of men employed and the number of accidents for 1923 and 1924 in the distribution department of the El Paso Electric Railway Company. These records are the result of a contest started Dec. 1, 1923.

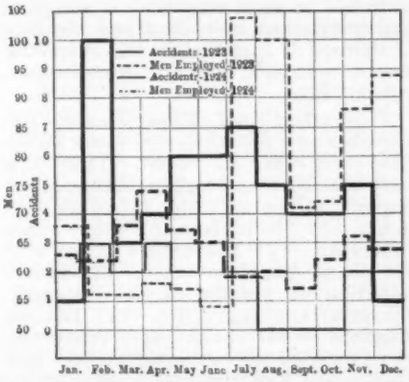


FIG. 1—MEN EMPLOYED AND NUMBER OF ACCIDENTS FOR 1923 AND 1924

THE BEST SAFETY DEVICE IS A CAREFUL MAN
NOTICE TO THOSE SEEKING EMPLOYMENT
UNLESS YOU ARE WILLING TO BE CAREFUL TO AVOID INJURY TO YOURSELF AND FELLOW WORKERS DO NOT ASK FOR EMPLOYMENT HERE. WE DO NOT WANT CARELESS EMPLOYEES
IF YOU ARE CAREFUL YOU EAT
IF YOU ARE CARELESS BEAUMONT EATS
BEAUMONT DIST. DEPT.
EL PASO DIST. DEPT.

FIG. 2—"SAFETY-METERS," WHICH SHOW COMPANIES' STANDING IN CONTEST

The success attending this contest, which was between the distribution department and the power plant, encouraged the distribution department of the El Paso Electric Railway Company to challenge the distribution department of the Eastern Texas Electric Company, Beaumont, Tex., for the year 1925.

The prize is to be a banquet tendered the winners at the expense of the losers, the money to be raised by popular subscription from the pockets of the losers. The challenge was accepted. To keep the department informed as to the relative standing of the two contestants two "safety-meters" have been made as shown in Fig. 2. Note the placard placed between the meters. This card is changed weekly.

Safety contest rules taking into account every bruise, cut or scratch that might lead to infection would probably do more harm than good, since there would be a tendency to minimize such minor injuries and ignore the iodine bottle for fear that the telltale stain might ruin the department's record. A summary of the adopted rules follows:

DEFINITIONS

For the purpose of this contest an accident shall consist of (1) an injury to an employee of such a nature as to render it necessary for him to be off the job for over two hours; (2) an injury to the public, or (3) damage to public property. For the purpose of this contest damage to the public or public property is sustained only in the event that a settlement is made either by the company or by insurance companies.

SCORING

Two hours will be allowed a man to take advantage of first-aid treatment; if after two hours he is unable to return to work, it shall count one point against his department for every hour or fraction thereof he is off, beginning with the hour of the accident. The maximum chargeable for any accident shall be eighty points. Against the contestant employing the fewer men at the end of the month, points shall count as outlined above, but for the department employing the most men, points as defined above shall be multiplied by a fraction having as a denominator the number of men employed by the department having the fewer men.

EXAMPLES

"A" has forty men at the end of month.
"B" has eighty men at the end of month.

1. Employee sticks splinter in hand, applies iodine and returns to work within two hours. If no infection results, this counts "no accident." If infection subsequently ensues and employee loses one day (eight hours), this counts eight hours plus the time originally taken out at time of applying iodine. Since the time lost originally to apply iodine was a fraction of an hour, this accident would count nine hours. Nine hours loss would count 9 points against "A," but would count only 40 ÷ 80 or ½ of 9 = 4½ points against "B."

2. Auto driven by employee collides with car driven by public. If no adjustment is paid the party, it shall be counted "no accident." If adjustment is paid, then it counts 4 points. This accident would cost "A" 4 points and "B" 40 ÷ 80 × 4 = 2 points.

3. If the above accident happens, auto is repaired and party is injured, it counts 8 points against the department having the fewer men.

4. If the above accident happens, auto is repaired, party is injured and employee loses eight hours as a result of injury:

Charge	4	points for damage to public property.
	4	points for injury to public.
	8	points for injury to employee.
Total	16	points

5. If some of the public collides with a light pole or picks up a live wire and is injured, it is not chargeable against the department's contest record.

6. If "A" employs forty-six men and "B" employs forty-eight men, the accident detailed above under (4) would cost "A" 16 points and "B" 46 ÷ 48 × 16 = 15.3 points.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Island Station of the St. Paul Gas Light Company.—This power station, recently put into operation, is designed as a stand-by plant and is equipped to burn pulverized coal. The present installation includes the first 25,000-kw. unit of a proposed three-unit plant. Some of the features are: Ventilated furnace walls and water screens to prevent slagging of ash, coal dried by flue gases, combination superheaters, stage bleeding of the main unit at four points. Economizers and air preheaters are omitted. The description is accompanied by charts showing results of boiler tests. The article, which is illustrated, concludes with a page of data on principal equipment.—*Power*, March 24, 1925.

Cost of Atomizing Fuel Oil.—CHAPLIN TYLER.—From a questionnaire sent to twenty-four manufacturers of fuel oil burner equipment the following over-all costs were calculated:

Hp.	Mechanical Atomizing System	Steam and Air Atomizing System
150	$5,000	$3,000
300	7,000	4,000
900	15,000	9,000
1,950	23,000	14,000
4,500	45,000	30,000

These figures include cost of burners, strainers, duplex pumps, heaters, underground storage tank, all necessary piping, valves, fittings and meters, together with the cost of installation under average conditions. On an assumed fixed charge of 22 per cent of the initial investment and certain unit costs, for which reference should be made to the original article, a table of costs per day is computed; from it the following totals are abstracted:

Hp.	Gal. per Day	Mechanical Atomizing	Steam Atomizing	Air Atomizing 8-Oz. Pressure	Air Atomizing 80-Lb. Pressure
150	1,000	$4.15	$4.68	$3.36	$8.00
300	2,000	6.09	7.89	2.63	7.27
900	6,000	13.98	21.48	13.56	41.40
1,950	13,000	23.11	42.50	25.34	85.66
4,500	30,000	47.40	96.40	56.80	196.00

—*Chemical and Metallurgical Engineering*, Feb. 23, 1925.

Transmission, Substations and Distribution

Swiss Substation at Puidoux.—W. HOLLIGER.—This is one of the largest European outdoor substations, and serves to supply the western part of the electrified roads of Switzerland. Designed and arranged for a capacity of 20,000 kva., there are at present installed two 5,000-kva. single-phase transformers to change the incoming 66 kv. to the traction voltage of 15 kv. at 16⅔ cycles. In addition, the station serves as distributing center, feeding ten lines at 15 kv. and four lines at 66 kv. Provision is made for adding two 11,000-kva. transformers with a voltage ratio of 66 to 132 kv. to tie in with a nearby hydro plant, which is, at present, not finished. The main transformers are of the self-cooled radiator and conservator type, and are equipped with safety valves to be pressure proof. Similar constructions are used on the two 100-kva. transformers for the station demand. All oil switches are remote control motor operated. Also some of the sectionalizing disconnects are remotely controlled. All oil switches have heating units to keep the oil from freezing in winter. To keep the large amount of oil in the many transformers and switches in good condition, a complete and permanent oil-boiling and filtering equipment is installed in the switching house.—*Brown, Boveri Mitteilungen*, April, 1925.

Theoretical and Experimental Researches on a Shunt Synchronous Phase Converter.—W. C. POPOV.—This is a very extensive and highly mathematical paper. It contains the following sections: (1) The scheme of a shunt phase converter. (2) The nature of work of the phase shunt converter. (3) Determination of tension of the balancer, converter and aggregate. (4) Tension diagram of the shunt phase converter. (5) Power of the converter and the balancer. (6) Experimental investigations of the shunt phase converter.—*Electritchestvo*, No. 2, 1925.

Units, Measurements and Instruments

Efficiency of End Connections, and the Short-Period Ratings of Large-Current Shunts.—S. W. MELSOM and H. C. BOOTH.—The efficiency of the end connections, which was discussed by a committee of the British Engineering Standards Association when considering the standardization of shunt ends and switchboard connectors, has been investigated. The results show that with brass lugs the contact resistance is considerably higher than with copper, and also that with brass ends the pressure-drop across the two joints is of the order of 20 millivolts as compared with 75 millivolts across the shunt itself. With copper ends the drop is only 3 millivolts. The temperature rise of the resistance elements of shunts carrying overloads was investigated. Formulas for the time during which short-period overloads could be carried without excessive heating were deduced from the dimensions of a typical shunt, both for a cold start and for a start after carrying normal lead, and these were checked experimentally.—*Journal of the Institute of Electrical Engineers (England)*, March, 1925.

One-Half Million Volt Direct-Current Set.—M. J. SAGET.—There are at present several sets for 250-kv. direct current in operation in France, which serve to energize Roentgen tubes for therapeutic treatment. A relatively very powerful set for this purpose has recently been shown in Paris, consisting of two series-connected halves for 250 kv. each, with the middle point grounded. This gave a total of one-half million volts at about 30 milliamperes, or an energy of 15 kw. direct current. All these sets employ Langmuir's kenotrons, manufactured by a French licensee. Combining these rectifying tubes with condensers and transformers, multiple voltages of 125 kv. can be obtained. In this manner sets have been made with two kenotrons for 125 kv., with four kenotrons for 250 kv., and the latest set with eight kenotrons for 500 kv. direct current. This high potential is measured only by the flash-over of gaps. It has been found that a sphere gap with 50-cm. balls flashes over at 500-kv. direct current when set for 28 cm., while a needle point gap will break down when set for 120 cm. The eight condensers for this set have a capacity of 0.06 microfarad each.—*Revue Générale de l'Electricité*, April 4, 1925.

Illumination

Periodic Eye Examinations in a Testing Laboratory.—NORMAN D. MACDONALD and JAMES W. SMITH, M.D.—Based on the results of periodical examinations of employees of the Electrical Testing Laboratories of New York during the past five years it is shown that for the best interests of both employer and employee no one should be accepted for employment, skilled or unskilled, without an examination to determine the condition of his eyesight. It was found that periodic examinations and treatment effected a gradual decrease of abnormalities, and that no given class of work in a testing laboratory was productive of eye strain. The first examination, in 1920, of sixty-four employees showed 41 per cent normal, 37 per cent normal after corrective glasses or treatment and 22 per cent having organic defects or diseases whose cases were postponed for further observation. In following the history of those persons in this group of sixty-four who continued with the company, it is interesting to note that since the first year, when 59 per cent were found to have eye defects, but 19 per cent were so recorded in 1922, 19 per cent in 1923, and 17 per cent in 1924. Other statistics classify the results by groups according to occupation.—*Transactions of the I.E.S.*, February, 1925.

Artificial Daylight Sources—C. SAMSON.—The very considerable difference between sunlight and the customary incandescent light makes an exact color distinction with artificial light impossible. Many attempts have been made to correct the artificial light to resemble daylight more closely. Filtering methods were tried at first; these, however, gave only approximate similarity between the two lights. In addition about 60 per cent of the light was lost by the filtration. Another method was taken by Sheringham, who utilized only light reflected from a surface coated with suitable colors. The result was better, but obviously the losses were still greater. This method required on an average ten watts per candle. The best and far most economical results can be reached with a light that contains in the first place only such components of light as obtain in sunlight. For example, a vacuum tube containing

carbon dioxide gas at very low pressure is excellently suited for such purposes. A light of this kind consists of a 5-m. long glass tube, bent into four close loops, consuming only 1,100 watts at 3,100 volts, giving 260 cp. at 4.2 watts per candle.—*Elektrotechnische Zeitschrift*, March 26, 1925.

Motors and Control

Ventilating the Liberty Tunnel in Pittsburgh.—ARTHUR MCGONAGLE.—This new vehicular tunnel is 5,888 ft. long and consists of two tubes, one for traffic in each direction. In order to maintain the carbon monoxide content of the atmosphere at a suitable dilution provision is made for supplying to each tube at least 280,000 cu.ft. of fresh air per minute. This is done by four ventilating fans, two blowing and two exhausting, driven through magnetic clutches by 85-hp. and 40-hp. motors respectively. These are direct-current machines. To meet special traffic conditions they can be operated at 25 per cent excess speed. Since this substantially doubles the power required, an additional motor is provided for each fan. The article gives views and lay-out drawings and describes the precautions taken to insure continuity of operation under all conditions.—*Electric Journal*, March, 1925.

Shape of Slots for Most Economic Motor.—L. OUTTIER.—The author shows that for a given size of induction motor more power output can be obtained if the slot cross-section is increased. Instead of providing rectangular slots in stator and rotor laminations, it is suggested to punch trapezoidal slots, which give more room for the windings or permit the introduction of copper bars of larger section. It is shown mathematically and on an example that this procedure will result in a 38 per cent higher output for a wound rotor motor and a 65 per cent increase for a squirrel-cage motor of about 2-hp. size. At the same time the efficiency is slightly improved in spite of a 10 per cent increase that occurs in iron losses.—*Revue Générale de l'Electricité*, March 28, 1925.

Squirrel-Cage Induction Motor With High Starting Torque.—T. F. WALL.—Earlier proposals to use compound conductors are cited. The feature of this machines lies in the use of compound rotor bars consisting of a central copper core surrounded by a sleeve of steel with a copper skin. Core and skin are in good electrical contact at each end. At starting, when the frequency in the rotor conductors is high, the reactance of the core forces most of the current to flow in the outer skin only. As the frequency decreases, with rising speed, the core comes into play more and more, thus gradually reducing the effective resistance of the bars. Since the permeability of the sheath, and therefore the reactance of the core, will vary with the current density, the effective resistance at a given frequency will also vary. Experiments were therefore made to find this relationship, as well as the effect of changing the thickness of the steel sheath. These are reported, but cannot readily be summarized in this brief abstract. Comparative tests of a 57-hp. motor having a special rotor made with the composite bars, and also with the standard rotor, show full-load starting torque, with respectively 2.45 and 3.37 times normal full-load current. As to power factor, there was a disadvantage of nearly 10 per cent, however, and as to efficiency about 2 per cent against the new motor. It appears to be the author's opinion that improvements in design can be made to eliminate these drawbacks wholly or in large measure, but in the discussion following the presentation of the paper the suggestion was made that the lower power factor was due to slot leakage by way of the steel sheath.—*Journal of the Institute of Electrical Engineers (England)*, March, 1925.

Heat Applications and Material Handling

Recent Developments in High-Frequency Inductive Heating.—DUDLEY WILLCOX.—The usual method of getting energy for the high-frequency induction furnace has been by connecting a reactance, a step-up transformer, a special form of discharge gap and a bank of condensers to a sixty-cycle circuit, whereby an oscillatory current of a frequency equal to the natural period of the furnace was made to flow in the latter. For the larger-capacity furnaces there has been developed an alternator that supplies 5,000-cycle current directly. The following items are abstracted from a table giving data on the melting of charges of approximately 600 lb. in the form of strips or scrap with a power rate between 85 and 100 kw.

Crucible	Metal	Lb. per Kw.-Hr.
Cold	Nickel-silver	3.98
Hot	Nickel-silver	5.23
Cold	Common brass	6.02
Hot	Common brass	8.9
Hot	Copper	5.53
Cold	Nickel-silver (in solid lump)	5.19

—*General Electric Review*, February, 1925.

Electrophysics, Electrochemistry and Batteries

Properties and Testing of Magnetic Materials.—T. SPOONER.—The present installment deals with properties rather than with testing. The normal hysteresis loop is given and the hysteretic characteristics of materials are discussed. Curves are given for the relation between coercive force, H_c, which is defined as the demagnetizing force necessary to bring the induction in the material to zero, and the residual induction or retentivity, B_r, that is, the induction when the magnetizing force has been reduced to zero. Other topics are: Saturation Effects, Relation Between H_c and Loss and Steinmetz' Law. It is shown that if two materials of different permeability and with different hysteresis coefficients are used in parallel, as happens when heavy scale is present on high-silicon electrical sheet, the ratio of variation is higher than the exponents of the individual components. Curves for a number of materials, showing various relations, accompany the article.—*Electric Journal*, March, 1925.

Traction

Regeneration of Energy in a Single-Phase Electric Locomotive.—PROF. A. B. LEBEDEV.—The article treats the question of the regulation of cos Θ during regenerative breaking in single-phase electric locomotives. The vector-diagram of the system, in which one part of a single-phase motor acts in the network as the main generator and the other as the excitator, is fully discussed. On the basis of this diagram a formula is deduced showing that the recuperative current varies along a parabolic curve. For regulating the cos Θ such a form is taken as to enable one, with a given value of cos Θ and at any speed, to fix the value of t, the voltage switched in for regulating the system. Indications are given as to the experimental construction of the theoretical diagram discussed in the paper.—*Electritchestvo*, No. 2, 1925.

Accidents on Electric Lines in Switzerland During 1924.—This paper represents the annual report issued by the Swiss Electrical Society, recording all the electrical accidents during the past year. The cases are tabulated according to high- or low-voltage accidents, the occupation of the injured, and the location of the accident. A large number of cases is recorded in detail. It is worth mentioning that voltages between 250 and 500 have caused five times as many accidents (forty-three cases) as voltages of more than 10,000 (eight cases). The history of many accidents should prove of great educational value to those in charge of electric safety movements.—*Bulletin de l'Association Suisse des Electriciens*, March, 1925.

Telegraphy, Telephony, Radio and Signals

The Marconi Wireless-Beam Reflector on Inchkeith.—N. WELLS.—To assist navigation a revolving radio "reflector has been erected on Inchkeith Island, in the Firth of Forth. The device consists of a set of tuned vertical wires arranged in the form of a parabolic cylinder, the transmitting aërial being at the focus. These are supported by a girder frame above and below, the whole structure being mounted on wheels running on a circular track. Spark signals of extremely short wave-length, 4.25 to 6.25 m., are sent out as the axis passes each half-point of the compass. The receiving aërial on shipboard is a rigidly supported rod about 7½ ft. long.—*Engineering (England)*, March 13, 1925.

Measurement of Cross-Talk.—A. H. DE VOOGT.—The author presents diagrams of two methods of measuring cross-talk, one using the "cross-talk meter," which gives the received current in the disturbed circuit in terms of millionths of the current in the receiving circuit, the other using an artificial line of variable attenuation and adjustable impedance, giving the $\beta\lambda$ value directly. These two are compared mathematically. It is stated that there may be a serious difference between the values by the two methods; the reasons for this are shown.—*Electrician (England)*, March 20, 1925.

New Books

Principles of Transmission in Telephony

By M. P. Weinbach. New York: Macmillan Company. 303 pages, illustrated.

In the past there have been too few books by American authors relating to the intricate problems of telephone transmission. It is gratifying to find one dealing exclusively with principles. The mathematical relations given in the first three chapters add to its completeness and make unnecessary frequent reference to other books. Since, in general, the student is without experience, it is difficult for him to apply abstract theory to engineering problems, and in this connection he will find the numerous examples which the author has worked out in detail of great assistance. The author has succeeded admirably in presenting this phase of the subject. This is particularly true where lines having different characteristics are connected together. The graphs assist in making clear the significance of the equations used. The chapter on "Line Impedance and Its Measurements" will be appreciated by those not having access to such information.

There are a few points that might be modified. Near the middle of page 7 reference is made to fractional and integral harmonics in a way that is likely to confuse the student. A statement indicating the conditions under which the fractional and integral harmonics occur would prove valuable. On page 20 in the fourth line from the top the expression "imaginary quantities" is used. "Imaginary forms" would perhaps be a better term. In Fig. 80 the condenser in the plate circuit is improperly connected. H. M. T.

Household Refrigeration

By H. B. Hull. Chicago: Nickerson & Collins Company. 328 pages, 80 diagrams and illustrations. Price, $3.50.

For those interested in the practical application and development of domestic electric refrigeration this treatise on the principles, types, construction and operation of ice boxes, with particular consideration to their use in the home, will prove a valuable source of information and reference. It deals with the general principles of refrigeration and traces the growth of its use down to the development of the devices which are now on the market. The author has presented the subject in its broadest aspect, and attention has been given to the production of refrigeration for any household or domestic purpose by both ice-cooled and mechanically cooled refrigerators.

Among the topical subjects discussed are "Refrigeration Units and Theory," "Ice for Refrigeration Purposes," "Refrigerants," "Heat Transfer," "Refrigerating Machines," "Types and Construction of Household Machines and Their Operation," "Testing of Refrigerators" and "Foods Requiring Refrigeration." Various tabular data are added. The whole text should be instructive to designers, manufacturers, sellers and retail distributors of household refrigerators, particularly in view of the popular interest in recent developments of the electrically operated type.

Einstein's Theory of Relativity

By Max Born, translated by H. L. Brose. New York: E. P. Dutton & Company. 293 pages, illustrated.

The translation of a work of this character is a difficult task, yet Mr. Brose has presented in English this splendid treatise on the Einstein theory. There are no advanced mathematics in the text, and the author has used a semi-historical method for bringing out the main relations of the theory. "Geometry and Cosmology," "The Laws of Mechanics," "The Newtonian World System," "The Laws of Optics," "The Laws of Electrodynamics," "Einstein's Special Principle of Relativity" and "Einstein's General Theory of Relativity" are chapter headings which give an idea of the scope of the work.

All engineers desiring to read and understand the new developments in science introduced by Einstein will find this book valuable, for the style is good, the explanations are lucid and the author writes in terms which may be understood by a reader with a fundamental scientific training.

Electrical Design of Overhead Power Transmission Lines

By W. T. Taylor and R. E. Neali. New York: D. Van Nostrand Company. 260 pages, illustrated.

The authors have treated the economic and technical features of transmission-line design for lines up to one hundred miles long and voltages up to 60,000. Quantitative treatment in tables and charts is given to conductors, systems, circuits, bases of line designs, loss calculations and minimum-cost design. The technical treatment calls for trigonometric approximate formula and graphs to obtain solutions. Skin effect and corona are discussed. English practice is basic in the text, and no attempt is made to employ the high-voltage long-line designs used in the United States.

The book lacks mechanical-structure design treatment and is not of a character to help American designers greatly as it deals with material found in handbooks. It is best when treating of economic principles of design and has some very useful charts and tables.

Physik in Graphischen Darstellungen

By Felix Auerbach. Berlin: B. G. Teubner. 1,557 illustrations on 257 sheets, with 30 pages of explanatory notes.

All physical problems can be solved either mathematically or by tabulation or graphically. The mathematical method gives, of course, the most complete solution in every case, but the graphical interpretation has the great advantage of giving the desired result in a manner which shows at a glance the character of the problem. In this unique and fascinating book the author has represented all the various problems of physics by the graphical method. The result is a book containing only curves and diagrams, with a few pages of necessary explanations. Many of these graphs are well known, as they have always been used in conjunction with the mathematical solution. But by far the largest number of the representations have been made specially for this book. Diagrams illustrating Einstein's optics of moving bodies, certain equations of Maxwell, ballistic laws, strength of materials, expansion of liquids and gases, dielectric laws, optical polarization, atomistic theories and many other phases of physics usually explained in a purely mathematical manner give an excellent conception of the problems considered.

A. P.

Book Notes

Hilfsbuch für die Elektrotechnik-Starkstrom Ausgabe. By Dr. Karl Strecker. Tenth edition. Berlin: Julius Springer. 740 pages, 560 illustrations.

This is the latest edition of Strecker's handbook for electrical engineers. A chapter on the now frequently used alignment charts has been added, and four chapters have been completely revised. To reduce the volume, formerly very bulky, the book is now being issued in two parts, telegraph, telephone and radio engineering being combined in a separate issue.

Problèmes d'Electrotechnique. By A. Curchod. Paris: A. Blanchard. 590 pages, 181 illustrations.

This book contains ninety-six practical problems, with their complete solution, in the course of which four hundred questions are answered and explained mathematically. The examples are chosen so as to cover practically the entire range of applied electricity. In each case a short summary is given of the fundamental principle used in solving the problem, followed by the introduction of concrete numerical values. The book is written as a guide for students in technical colleges.

Elektrische Maschinen. Volume I. By Rudolf Richter. Two volumes. Berlin: Julius Springer. 630 pages, 453 illustrations.

A textbook in two volumes for a three-semester college course on calculation and design of electric machines and transformers. The first volume contains fundamentals for general calculations and the theory of direct-current machines, while the second comprises alternating-current problems.

Handbuch der Elektrischen Raumheizung. By W. Heepke. Second edition. Halle: C. Marhold. 264 pages, 153 illustrations.

The subject of room heating by electricity is presented in a small handbook brought fully up to date. Great value has been placed on practical examples with data from actual installations. Of particular value is the information on heating of halls, churches and other large premises.

Höhere Mathematik. By Dr. R. Rothe, Berlin: B. G. Teubner. 185 pages, 155 illustrations.

A short and condensed textbook of higher mathematics, intended primarily for students in technical colleges. The fundamental methods of calculus are developed and explained in 115 exercises.

Books Received

Telephone Communication. By Charles Allen Wright and Albert Frederick Puchstein. New York: McGraw-Hill Book Company, Inc. 515 pages, illustrated. Price, $5.

Transmission Circuits for Telephonic Communication. By K. S. Johnson. New York: D. Van Nostrand Company. 326 pages, illustrated. Price, $5.

Constructive Merchandising. By Robert E. Ramsey. New York: D. Appleton & Company. 718 pages, illustrated. Price, $6.

Foundations of the Universe. By M. Luckiesh. New York: D. Van Nostrand Company. 245 pages, illustrated. Price, $3.

News of the Industry

Against Delaware Charter

Associated Gas & Electric Plans to Merge Subsidiaries Upset by New York Commission

A DECISION of far-reaching importance affecting the interstate combination of electrical companies was rendered by the New York Public Service Commission on May 5 when it denied its consent to the sale to the Consumers' Electric Service Corporation, organized under the laws of Delaware, of the capital stock of the Harlem Valley Electric Corporation and of the Amenia Electric Light & Power Company. At the same time the commission refused to approve the sale to the Harlem Valley Electric Corporation of the Morgan & Wyman Electric Light & Power Company of Dover, the Lebanon Valley Lighting Company of Canaan, the Chatham Electric Light, Heat & Power Company, the Carmel Light & Power Company and the Cold Spring Light, Heat & Power Company. It also refused to approve the sale of the Katonah Lighting Company to the Ridgefield Electric Company of Connecticut. All the companies named operate in counties on the Connecticut border, and the plan to merge them was noted in the ELECTRICAL WORLD for February 21, page 420.

At the hearings it was brought out that the capital stock of all the companies involved was held by individuals affiliated with the Associated Gas & Electric Company. Chairman Prendergast expressed his belief that a combination of the various companies under one general operating management which would eliminate unnecessary overhead charges would be in the public interest, but he went on to say:

"It is just as important, however, that the combination, if effected, should be upon a proper financial basis and that the properties should be fairly capitalized, in order that the consumers may get the benefit of better service and equitable rates; but such a result might be entirely negatived if the properties should be controlled by interests not subject to the jurisdiction of the commission. It is obvious if the petition of the Consumers' Electric Service Corporation, which is a foreign corporation, is granted, it will control these properties, it in turn to be controlled by the Associated Gas & Electric Company.

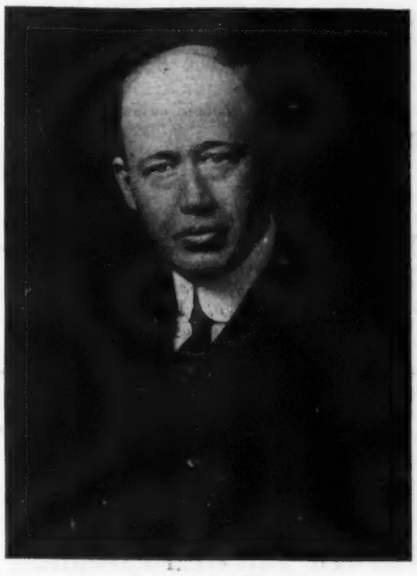
"Why it should be necessary to resort to the expedient of putting these companies in control of a Delaware corporation has not been disclosed, and certainly no sufficient reason has been offered therefor. It is difficult even to conjecture what public interest would be served thereby. The same interests control all of the New York State companies concerned in these petitions. It certainly should be possible to present a plan which would in a satisfactory way bring about a commendable combination of these companies. The petitions in their present form do not accomplish this and should be denied."

One reason urged for the sale of the Katonah company to the Ridgefield company was that the Ridgefield company will be in a position to extend financial aid to the Katonah company. Chairman Prendergast holds in his opinion that since the Associated Gas & Electric Company interests control both companies they could as well furnish the Katonah company directly with the better financial and operating advantages it requires as through the medium of the Ridgefield company.

The commission likewise refused to approve the exercise of a franchise of the Ridgefield company in the town of Lewisboro, which is in the Katonah company's territory. The commission held that although the company had been serving some customers there for several years, it had been doing so without the sanction of the commission and that the interests owning both companies should make arrangements to have the Katonah company take over the customers being served by the Ridgefield company within New York State.

Death of Milan R. Bump

Prominent Engineer and Former President of National Electric Light Association Passes Away Unexpectedly at Denver—Sketch of His Career



MILAN R. BUMP

FRIENDS and professional and business associates of Milan R. Bump, chief engineer for Henry L. Doherty & Company, New York, and former president of the National Electric Light Association, were shocked on Tuesday of this week by the news of his death, which occurred at Denver, Col., at 3 o'clock in the morning of that day. Death followed two days' illness due to hemorrhage of the nose and heart trouble.

Milan Raynard Bump was born at Rock Falls, Wis., March 18, 1881. His boyhood was passed in Spokane, Wash., where he received his early education in the public schools. He entered the University of Wisconsin in the fall of 1898 and was graduated with a degree of B.S. in electrical engineering in 1902. He immediately entered upon engineering work with the Washington Water Power Company, but in 1903 returned to Madison, Wis., where he pursued his engineering studies and served for one year as an instructor in electrical engineering at the University of Wisconsin.

In 1904 Mr. Bump became associated with Henry L. Doherty as the first cadet engineer of the Doherty training schools. From 1904 to 1906 he was engineer for the gas department of the Denver Gas & Electric Light Company, one of the first Doherty properties; from 1907 to 1909 he was examining engineer for Henry L. Doherty & Company, and in the latter year he removed to Joplin, Mo., where he was instrumental in consolidating electric utilities of the lead and zinc district and forming the Empire District Electric Company, of which he became treasurer and general manager. He also designed and erected a large modern steam plant and an extensive transmission system covering the entire mining field. In 1910 Mr. Bump was transferred to New York as chief engineer of all the Doherty interests.

From 1910 to 1915 Mr. Bump was engaged largely in examining for purchase and improving many of the public utility properties which now make up the subsidiaries of the Cities Service Company. He had charge of all engineering and of the construction and operating departments of the public utility division, later becoming a member of the executive committee of the Doherty organization and assuming charge of oil transportation, the refining and marketing divisions and the natural-gas division, in addition to the engineering and technical activities of the organization. He was an officer, a director or both in ninety-five separate properties.

In 1915 Mr. Bump interrupted his service with the Doherty organization and became vice-president of the Eagle-Picher Lead Company in Joplin, but he soon returned, largely on account of missing the close associations and friendships he had formed.

Mr. Bump was always active in public utility affairs and served on many committees of the National Electric Light Association and other engineer-

ing societies. After four years' service as a vice-president of the N. E. L. A., he was elected to the presidency at the Chicago convention of 1921 and served with ability and distinction during the ensuing year. He was one of the early and ardent advocates of customer ownership of securities and a convinced believer in the importance of good public relations.

Mr. Bump was a member of the American Institute of Electrical Engineers, the American Electric Railway Association, the American Electrochemical Society, the Society for the Promotion of Engineering Education, the New York Electrical Society, the Engineers' Club of New York and other technical and social organizations. He was married in 1909 to Miss Mary Morrison of Joplin, Mo., and left three children. His home was in Montclair, N. J.

MR. DOHERTY'S TRIBUTE

Henry L. Doherty gave to the ELECTRICAL WORLD the following tribute to Mr. Bump, who had for so long been one of his right-hand men: "The sudden illness and death of Milan Bump was a great shock to me. He was cadet number one in the first regularly organized training school for engineers that I formed in Denver in 1904. From his start as a cadet and pupil he soon became an able teacher and preceptor. He had an exceptionally accurate mind, was an able engineer and possessed of keen and high ideals. Every one in our organization trusted him, loved him and admired him."

Object to Export Duty

Ontario Hydro Consumers Want Ottawa to Exempt Power Now Sold Under Contract

THE Canadian government had a double object in placing the export tax on electrical power—to secure revenue and to discourage the export of power—J. A. Robb, Acting Minister of Finance, informed a large delegation from the Ontario Hydro-Electric municipalities, who waited on the government last week to urge that the 60,000 hp. exported annually by the Ontario Hydro-Electric Power Commission under a contract with the Niagara, Lockport & Ontario Power Company should be exempted from the new tax. It was pointed out that the contract had been made in 1904 and would not expire until 1950. The yearly tax on power in this case would amount to $110,000, the delegation said, and would have to be borne by the Ontario consumers.

Mr. Robb observed that the act to regulate power export was passed in 1907 and it was not till ten years later, and in full knowledge of the existence of the act, that the Hydro took over the Ontario Power Company and with it the contract for the export of power which the Ontario Power Company had made with the Niagara, Lockport & Ontario Power Company.

In an interview given in Montreal recently Senator Henry Miles, discussing the difference between exports of pulpwood and exports of power, said that in the matter of pulpwood exports, it was patent that the exports did not replace themselves—at least not for generations. "But in the matter of exporting power generated from hydro-electric energy the situation is entirely different," he said. "The highest engineering authority claims that it will take three hundred years to provide a market in Canada for available water-power developments, and only then with an enormously increased population. In the interval the powers are running to waste, and with them a huge source of revenue to Canada."

Canadians Support Carillon Falls Power Exportation

Replying to a delegation representing municipalities in the district surrounding Ottawa, Canada, which asked the federal government's approval of the proposal to export power developed at Carillon Falls, Premier King stated that the national interests of Canada would be the first consideration of the government in dealing with applications for the export of electrical power.

J. A. C. Ethier, Liberal member of Parliament for Laval, Two Mountains, Quebec, who introduced the delegation, expressed the opinion that Canada would not require during the next century and a half more than a small proportion of the 400,000 hp. capacity of the proposed plant at Carillon. He said the Northern Electric Company was prepared to spend $52,000,000 on the plant.

Premier King agreed that Canada should sell her surplus power. He asked if the United States consumers were likely to object if Canada imposed "strong reservations providing for the return of the power when Canada needed it." Mayor Brown of Point Fortune, Quebec, replied that United States interests were willing to invest their money in return for the power received. They probably would be quite willing to recognize Canadian government restrictions consistent with reason, he said. The Premier promised careful consideration of the representations of his visitors.

Institute Will Hear Executives on Rail Electrification

Edwin M. Herr, president Westinghouse Electric & Manufacturing Company; Gerard Swope, president General Electric Company; Paul Spencer Clapp of the Department of Commerce and Robert J. Cary, general counsel New York Central Lines, are to speak on "Steam Railroad Electrification from the Executives' Standpoint" before the annual meeting of the American Institute of Electrical Engineers at the Engineering Societies Building, New York, on May 15, at 8.15 p.m. In addition to their discussion addresses by Secretary Hoover and C. H. Markham, president Illinois Central Railroad Company, will be presented. This unusual and important session will follow the business meeting, at which the reports on the election of officers and the proposed constitutional amendments will be submitted.

Non-members are invited to hear the addresses, which will be widely transmitted by radio.

General Electric Assailed

Untermyer Attacks the Government's Procedure in Suit—Young Denies Accusations

SAMUEL UNTERMYER, who was counsel for the Lockwood legislative committee in New York State, which three years ago investigated charges of unlawful monopoly against the General Electric Company in connection with the manufacture of lamp bulbs under its patents, has written a long letter to Owen D. Young, chairman of the board of the General Electric Company, in which he accuses Mr. Young of issuing a misleading letter to the company's stockholders regarding the outcome of the suit brought by the United States Department of Justice against the company. This suit, it will be remembered, was dismissed by the United States District Court in Cleveland.

Mr. Untermyer charges, in effect, that because of collusion a charge of criminal conspiracy was not brought against the company, but that the suit "was, on the contrary, carefully and guardedly restricted to an attack upon the mere form and character of the contracts and methods of dealing as between the company and its agents and customers." He further accuses the General Electric Company of being dominated by J. P. Morgan & Company. In another letter, addressed to Basil M. Manly, director of the People's Legislative Service, Mr. Untermyer urged that Mr. Manly collect "the evidence on which to place this miscarriage of justice before the next session of Congress, to the end of bringing about an investigation that will uncover the facts and force a legitimate prosecution of these powerful offenders." Mr. Manly promised to proceed along the lines thus suggested.

Mr. Untermyer's attack has brought emphatic contradiction from Mr. Young, who in a reply to his opponent's letter says:

"So far as the Department of Justice is specifically concerned, we have furnished the facts, and all of the facts, requested in its long and most complete inquiry into our affairs. When the department brought suit against us to test the validity of our method of dealing with our incandescent lamp patents and our commercial method of distributing our lamps, our case was presented to the federal court and it rendered a decision in our favor. It was the notice of this decision which we sent to our shareholders in order that they, who are vitally concerned, might know the truth."

No honest charge of criminal monopoly could be brought against the company, Mr. Young declares. He scouts the assertion that the firm of J. P. Morgan & Company or any other banking group controls the company and further declares: "Since I have been chairman of the board—and speak of that period only because I know—no person has been authorized in behalf of the General Electric Company to ask, and I believe no one has asked, any member of the federal government to act or refrain from acting in any matter of special interest to the General Electric Company," excepting normal and perfectly proper administrative requests.

Real Progress Evident at The Hague

With New Plan of Procedure, Delegates to I. E. C. Deal with Traction Motors, Temperature Rating, Prime Movers, Lamp Caps, Symbols and Transformer Oil

GRATIFYING enthusiasm and a genuine spirit of co-operation were manifest among the hundred delegates to the meeting of the International Electrotechnical Commission that took place at The Hague, Holland, on April 16 to 23. The plan of introducing new subjects by the reading and discussion of papers by experts gave excellent results, clearing the air for definite proposals for rules later. In this way much time was saved in the discussion of rules. The plan was used in introducing the subjects of traction motors and transformer oil, advisory committees meeting on these for the first time.

Traction Motors.—The one-hour rating for traction motors advocated by the United States committee was objected to on the ground that it had no scientific basis and no definite relation to service conditions. It was agreed, however, that traction motors require some test other than that necessary to determine temperature limits on continuous load, and the principle of the one-hour plus the continuous rating was unanimously accepted. The United States commission proposals as to temperature rises were substantially met by some of the other national bodies and were finally accepted.

The proposals for commutator temperatures recommended by the I. E. C. for adoption are: For the one-hour test, 90 deg.; for the continuous test, 85 deg. The American proposal was for 95 deg. and 80 deg. It was decided that all tests shall be made with ventilation as arranged for service, the efficiency to be the summation of losses corrected to 75 deg., but not to include gear losses.

Terminal Markings. — The advisory committee on terminal markings found itself confronted with different schemes from each nation, and as there seemed to be no hope of bringing about a plan acceptable to all, it was decided to attempt a dictionary or concordance which would at least allow an international understanding to be arrived at between nations which have adopted a definite national scheme.

Rating.—The principal matter of rating dealt with had to do with the use of embedded temperature detectors and the limiting temperatures allowable by this method of measurement. There were some differences in the figures proposed by the various national committees and the subject was very thoroughly discussed with a final unanimous adoption of the following ratings:

For Rotors	Limiting Rise—Class A	Limiting Rise—Class B
Steam-turbine-driven motors...	Not employed	90 deg. C.
Salient-pole machines	60 deg. C.	80 deg. C.
For stators, two coil sides per slot	60 deg. C.	80 deg. C.

For stators with one coil side per slot employing grade B insulation 85 deg. C. was decreed when the detector is placed against copper and 70 deg. C. when the detector is placed at top or bottom of slot. The latter figure is to be decreased 1½ deg. for each 1,000 volts (rated voltage) above 7,000. (The United States does not employ the one-coil-side-per-slot construction.)

The limit in the size of machines on which embedded temperature detectors are to be used is in the case of salient-pole machines a core length of one meter or greater and in the case of turbo-generators a rating 5,000 kva. and above.

The rating of general-purpose motors was not dealt with.

Prime Movers.—The advisory committee on prime movers had before it a mass of data with many ideas as to scope, procedure, etc. It finally decided to ask the various national committees to make proposals on four codes: (a) Steam turbines, (b) water turbines, (c) reciprocating engines, (d) internal-combustion engines. Both metric and British measures are to be used, and the general form and main chapter headings were agreed on. All codes are to have uniform method of treatment. No specific propositions or figures were adopted.

Lamp Caps.—The advisory committee on lamp caps (bases and sockets) agreed to ask the international manufacturers' technical committee to prepare the final draft of the standards on this subject, these to include only those limits necessary to insure interchangeability in use. It is also hoped to publish international standards for bayonet sockets.

Symbols.—The symbols committee gave detailed consideration to the various proposals, and final agreement was reached on a considerable number of symbols which will go forward for publication.

Vocabulary.—For the first time very substantial progress was made on an international electrical vocabulary. Much individual work has been done on this subject, especially by Dr. C. O. Mailloux, and a preliminary publication may be expected in the not distant future.

Transformer Oil.—Perhaps more interest was shown on the subject of transformer oil than on any other subject considered. The papers by the experts were listened to with close attention, and the subject was discussed by delegates from nearly all nations present. The main discussion centered on the sludge test. Eight or ten methods were advocated, but there was universal agreement that no known method could yet be considered standard. The invitation of the American Society for Testing Materials, through the United States committee, to the European countries to participate in a series of tests on various grades of oils by various methods was accepted, and a committee of three was appointed to supervise the carrying out of these international tests. Precise outlines are to be prepared and distributed, and samples of known oils are to be furnished to the participating laboratories. It is hoped that these tests will result in providing a method or methods that will give concordant results as well as a measure of the sludging characteristics of the oil in service.

It was decided that the following points should be taken into account in judging results: (a) Development of acid with time; (b) time required for first appearance of sludge; (c) rate of sludge formation when started.

Decision was taken to recommend the Pensky-Martin closed cup for taking flash point, and a figure of 145 deg. C. for flash point was discussed but no final decision taken.

A considerable number of national delegations filed documents on test methods and test values, and these were ordered distributed for further study. The United States committee took the ground that no specifications for values could be made until there was international agreement as to the methods and apparatus for determining those values.

Entertainment Features

Excellent arrangements were made by the Dutch committee for the convenience, comfort and pleasure of the delegates. Especial credit must be given to Dr. Prof. Feldmen, president of the committee; to Mr. Tromp, Director Verversdijk and the officers of the Royal Engineering Society of Holland. The meetings of the I. E. C. were held in the latter's fine headquarters building. On Thursday, April 16, the Dutch committee tendered a luncheon to the delegates, and on Tuesday evening, April 21, a formal dinner at Hotel Twu Stadden. On Saturday, through the kindness of the Dutch committee, an excursion was made to Haarlem and through the tulip fields, which were in full bloom. The international flower show at Haarlem was visited as well as many points of technical interest, such as the locks in the ship canal to Amsterdam, which when completed will be the largest in the world.

Electric Rates in San Francisco Attacked

Demand for an investigation of the electric rates charged in San Francisco by the Pacific Gas & Electric Company and the Great Western Power Company is contained in a resolution presented to the Board of Supervisors of that city on April 27. The resolution recites that reports filed with the Railroad Commission by the two utilities show that the Pacific Gas & Electric Company derived 34 per cent of its gross revenue from sales of 27.9 per cent of its energy in the city during 1924, and that the Great Western Power Company sold 23.4 per cent of its power in the city, for which it received 36 per cent of its gross revenue.

It is further declared that the average retail revenue of 3.68 cents per kilowatt-hour in San Francisco is 50 per cent higher that the average retail return from consumers on the rest of the system. No action was taken on the matter by the Board of Supervisors pending a report of the public utilities committee.

Montreal Company Plans to Lay 60,000-Volt Cables

In the construction budget of the Montreal Light, Heat & Power Company for the current year is included the building of a new power station which, it is said, will be the largest substation for city distribution on the continent. The station is designed for a capacity of 60,000 kw. and will be divided into four potentially independent sections by concrete walls. The present load in the district which it will serve is 37,000 kw. Provision will be made for delivery to the substation of a current of 60,000 volts by underground cables from the generating plants. This rating is not surpassed by that of any underground cable in the United States except the 66,000-volt installation in Cleveland. The station will be laid out for a total of eighty distribution feeders radiating to all the central parts of the city. The main control station will be located on the top floor. Various new technical features will be introduced in the equipment, the result of months of study of the most modern substations in the United States.

Muscle Shoals Commissioners Confer Informally

Questions involved in the Muscle Shoals inquiry were discussed informally this week by Commissioners Curtis, McClellan and Bower. The conferences were held at the headquarters of the commission in the rooms of the military affairs committee of the House of Representatives, but the gathering was not designated as a meeting of the commission. Professor Curtis stated that he has been devoting much of his time to a study of the existing processes of nitrogen fixation with the idea of forming his own opinion as to whether or not any one of them has been brought to a commercial stage. In his opinion, one of the fundamental points which must be established before the commission can make recommendations is the prospect of successful operation on a commercial basis. Commissioner McClellan has devoted much of his time thus far to a study of the literature which has been built up since the disposition of the government's Muscle Shoals properties came up for discussion in Congress.

San Joaquin Light & Power Program for 1925

A development program for this year involving the expenditure of $8,000,000 and the construction of a 28,500-kw. hydro-electric plant has been announced by A. Emory Wishon, vice-president and general manager of the San Joaquin Light & Power Corporation, Fresno, Cal. In this year's budget $1,250,000 has been allotted for construction work on the Balch plant of the Kings River project. This plant will cost $5,000,000 and be ready for operation January 1, 1927.

In addition to the work on the new power plant, the expansion program includes the building of several substations of large capacity, the enlarging of others and the construction of hundreds of short transmission and distribution lines throughout all parts of the ten counties served. Business and agricultural conditions in the San Joaquin Valley are rapidly recovering from the depression of 1924, and bumper crops have been assured by ample rainfall.

More agricultural load has been connected to the lines of the company this year than in any similar period in the history of the company. In the first three months of 1925 11,000 hp. in agricultural motors was added, an increase of nearly 3,000 hp. over the same period of last year. During the coming year the company will have available 25,000 hp. from the Exchequer plant of the Merced Irrigation District, a contract for this power for a period of years having been made. This will meet the growth in load until the completion of the Balch plant.

Southwestern Public Service Association Meets

Convening on Tuesday, May 5, at Houston, Tex., the Southwestern Public Service Association was still in session as the ELECTRICAL WORLD went to press. The comprehensive program and abundant recreational features insured an entirely successful meeting. The Electric Service Section, meeting on Wednesday, Thursday and Friday, carried out the program printed on April 25, page 890. A feature of this convention was the two sessions of the small-plant division on Thursday and Friday, in which the papers and discussions of the problems of the smaller electric light and power companies attracted much interest.

De Forest Radio Company Makes Sensational Charges

Affidavits filed in an injunction suit brought at Trenton, N. J., last week by the De Forest Radio Company against the Radio Corporation of America allege that agents of the Radio Corporation of America in the De Forest Radio Company's plant furnished the Radio Corporation with valuable information concerning secret methods of manufacturing radio apparatus, and with the names and addresses of employees, the number of radio tubes produced, addresses of persons and concerns dealing with the De Forest company and other information pertaining to the De Forest company's business, as well as with drawings of machines and samples of products made by the De Forest company.

General J. G. Harbord, president of the Radio Corporation of America, denying that his company had engaged in improper business practices, said that it had endeavored to locate infringements of its patents and with some success. Suit for a temporary injunction, General Harbord said, was begun before his company was notified, and he learned of it first through the newspapers.

A further charge made, this time in an affidavit by President Theodore Luce of the De Forest Radio Company, is aimed at the General Electric Company, which is accused of buying up the Electron Relay Company of Toledo in order to cut off from the De Forest company its source of filament wire. Litigation between the De Forest company and the Radio Corporation in connection with the sale of audion tubes is before the federal court in Delaware.

Nearly Ready for San Francisco Meeting

Program Is Out with a Few Features Still to Be Added — Five Thousand Delegates Expected to Attend—Prominent Statesmen and Publicists Will Make Addresses

ON THE opposite page is printed the tentative program for the forty-eighth convention of the National Electric Light Association at San Francisco next month, when approximately five thousand representatives of electric light and power companies in the United States and Canada are expected. A glance at the program shows its comprehensive nature.

Sixteen business sessions will be held during the four days of active convention work on June 16, 17, 18 and 19. The general sessions will be four in number, the Public Relations National Section, the Commercial National Section and the Technical National Section will each hold three meetings, and the Accounting National Section will hold two meetings. All these sessions will be held in the San Francisco Civic Center. On Wednesday night the public policy meeting will be held in the main auditorium of this building, and this year, as in former years, it will be a principal event of the convention. Secretary of Commerce Hoover has been invited to be the principal speaker. During the week many other men of national importance will address the convention. Among them will be F. W. Richardson, Governor of California; William M. Jardine, Secretary of the Department of Agriculture; L. J. Tabor, master of the National Grange; Colonel William Kelly, former chief engineer of the Federal Power Commission; Edward N. Hurley, former chairman of the United States Shipping Board; William F. Durand, president American Society of Mechanical Engineers; Paul Shoup, president Southern Pacific Railroad Company, and W. D. B. Ainey, president National Association of Railway and Utilities Commissioners.

During the hours when business sessions are not being held visitors will find a wide choice of entertainment provided for them, including golf, tennis, dancing, cabaret entertainment, music, tours, boat trips, and card parties and teas for the ladies. The president's reception will be held on Monday evening, June 15, at the Fairmont Hotel. The forepart of that day will be given over to registration. Later there will be a formal ball.

N. E. L. A. 1925 Convention Program

SAN FRANCISCO, JUNE 15-19

(Subject to Augmentation or Slight Change)

General Sessions

TUESDAY, JUNE 16, 9:30 a.m.

Address, "Welcome to California," Governor F. W. Richardson.
Address, President Franklin T. Griffith.
Report of treasurer, W. A. Jones.
Report of finance committee, J. B. McCall.
Report of Managing Director M. H. Aylesworth.
Report of constitution and by-laws committee, W. C. L. Eglin.
National Section reports: Public Relations, M. S. Sloan; Accounting, W. Paxton Little; Commercial, W. R. Putnam; Technical, H. P. Liversidge.
Address, Colonel William Kelly.

WEDNESDAY, JUNE 17, 9:30 A.M.

Report of educational committee, Fred R. Jenkins.
Report of lamp committee, Frank W. Smith.
Report of committee on electrification of steam railroads, Frank R. Coates.
Address, "The Necessity of Moving On," Paul Shoup, president Southern Pacific Railroad Company.
Address, W. D. B. Almey, president National Association of Railway and Utilities Commissioners.
Address, F. A. Wilson-Lawrenson, publisher *Hearst's Atlanta Georgian.*

THURSDAY, JUNE 18, 9:30 A.M.

Report of prize awards committee, W. H. Onken, Jr.
Report of lighting educational committee, J. E. Davidson.
Address, Miss Julia Groo, first prize winner in home-lighting contest.
Report of membership committee, Howard K. Mohr.
Report of water-power development committee, W. E. Creed.
Report of rural electric service committee, G. C. Neff.
Report of committee on the relation of electricity to agriculture, E. A. White.
Address, William M. Jardine, Secretary of Agriculture.
Address, L. J. Tabor, master National Grange.

FRIDAY, JUNE 19, 9:30 A.M.

Report of wiring committee, R. S. Hale.
Report of United States Chamber of Commerce National Industrial Conference Board, John W. Lieb.
Report of rate research committee, Alex Dow.
Address, "What Electricity Is Doing for Women," Mrs. John D. Sherman, president General Federation of Women's Clubs.
Report of insurance committee, Charles B. Scott.
Report of committee on contact with Department of Commerce, George H. Harries.
Report of memorials committee, W. H. Onken, Jr.
Election of officers and members executive committee.

Public Policy Committee Session

WEDNESDAY, JUNE 17, 8:30 P.M.

Report of public policy committee, Martin J. Insull.
Address, Herbert Hoover, Secretary of Commerce.
Report of Charles A. Coffin prize committee, Frank T. Griffith.
Award of Coffin medal.

Public Relations Sessions

TUESDAY, JUNE 16, 2:30 P.M.

Address, Chairman M. S. Sloan.
Report of advertising survey committee, Joseph B. Groce.
Report of committee on co-operation with educational institutions, John C. Parker.
Report of industrial relations committee, Homer E. Niesz.
Report of manufacturers' advertising committee, J. C. McQuiston.
Report of public speaking committee, W. S. Vivian.
Report of committee on uniformity of state regulatory laws, W. W. Freeman.

WEDNESDAY, JUNE 17, 2:30 P.M.

Report of women's public information committee, Miss R. E. McKee. Discussion led by the chairmen of the women's public information committees of the geographic divisions.
Report of committee on information bureau organizations, H. C. Abell. Discussion by Charles L. Edgar, chairman New England Bureau of Public Service Information; Bernard J. Mullaney, director Illinois Committee on Public Utility Information, and the directors of the other state public utility information bureaus.

THURSDAY, JUNE 18, 2:30 P.M.

Report of customer ownership committee, A. Emory Wishon.
Report of committee on relations with financial institutions, M. S. Sloan.
Symposium on "Electric Light and Power Company Finance," B. C. Forbes, editor *Hearst's Publications*; S. Z. Mitchell, Alfred L. Loomis and Martin J. Insull.

Accounting Sessions

TUESDAY, JUNE 16, 2:30 P.M.

Address, Chairman W. Paxton Little.
Report of budget committee, Robert B. Grove.
Report of committee on classification of accounts and annual reports, W. J. Meyers.
Report of committee on customers' records and billing methods, W. H. Cassell.
Report of committee on filing and preservation of records, Franklyn Heydecke.
Report of committee on fixed capital records, G. U. Stewart.
Report of payroll standardization committee, W. J. Vega.
Report of committee on purchasing and storeroom accounting, K. C. Campbell.
Report of security accounting committee, T. A. Wallace.

WEDNESDAY, JUNE 17, 2:30 P.M.

Address, speaker and title to be announced.
Address, "Indispensable," P. S. Arkwright, Atlanta.
Address, W. R. Putnam, chairman Commercial Section.
Address, M. S. Sloan, chairman Public Relations Section.
Address, H. P. Liversidge, chairman Technical Section.
Address, "The Accountant's Relation to Rate Cases," H. M. Brundage.
Address, "Scope of Activities of the Accounting National Section," H. M. Edwards.

Commercial Sessions

TUESDAY, JUNE 16, 2:30 P.M.

Address, Chairman W. R. Putnam.
Report of industrial lighting committee, Joseph F. Becker.
Report of electric cooking and heating committee, A. C. McMicken.
Address, "Merchandising Electrical Appliances," Edward N. Hurley.
Report of appliance committee, Thomas W. Berger.

WEDNESDAY, JUNE 17, 2:30 P.M.

Report of customer relations committee, F. F. Kellogg.
Report of electric refrigeration committee, G. E. Miller.
Report of power committee, V. M. F. Tallman.
Address by speaker representing power committee.

THURSDAY, JUNE 18, 2:30 P.M.

Report of transportation committee, B. J. Martin.
Report of street and highway lighting committee, E. W. Lloyd.
Report of lighting committee, C. C. Munroe.

Technical Sessions

TUESDAY, JUNE 16, 2:30 P.M.

Address, Chairman H. P. Liversidge.
Report of accident prevention committee, Charles B. Scott.
Report of electrical apparatus committee, A. A. Meyer.
Report of hydraulic power committee, R. L. Hearn.
Report of inductive co-ordination committee, H. S. Phelps.
Report of meter committee, B. Currier.
Report of prime movers committee, Nicholas Stahl.
Report of overhead systems committee, W. G. Kelley.
Report of underground systems committee, W. H. Cole.

WEDNESDAY, JUNE, 17, 2:30 P.M.

Address, "Some Factors Affecting the Relation of Steam and Water Power in Combined Systems," Herbert A. Barre.
Address, "Special Features in Western Turbine and Waterwheel Design," Ely C. Hutchinson.
Address, Colonel William Kelly.

THURSDAY, JUNE 18, 2:30 P. M.

Address, "The Spirit Which Permeates the Service of Our Utilities," H. Birchard Taylor, vice-president Wm. Cramp & Sons Ship & Engine Building Company.
Address, "The Status of the Engineer," R. F. Pack.
Address, "The Engineer as a Factor in Human Affairs," William F. Durand, president A. S. M. E.

Expansion in Iowa

With Three Major Central Stations 1925 Will Set Record in Electric Construction

THE year 1925 will witness the greatest expansion of public utilities in the history of Iowa. Improvement projects to cost $50,000,000 are under way to meet demands for service brought about by the resumption of normal business activities. The steam generating capacity of electric stations will be more than doubled, and approximately 1,000 miles of high-voltage transmission lines will be built. Three new electric generating stations alone —those at Des Moines, Davenport and Sioux City—will increase the state's capacity 200,000 hp. before the end of the year. The state's present steam capacity is less than 200,000 hp. The ultimate generating capacity of these three plants will be 465,000 hp.

The territory served from Cedar Rapids is being provided with additional power facilities by the installation of large new units at the present modern generating station. New high-voltage lines are connecting Iowa with generating stations in adjoining states and making available immense power resources. The electrical engineering department of the Iowa Railroad Commission is passing on projects calling for the building of hundreds of miles of transmission lines. There are now 8,000 miles of such lines, and it is expected that there will be 9,000 miles before the end of the year. Old lines are being rebuilt. Isolated towns or groups of towns formerly served by small generating stations are being interconnected.

Spring Meeting Program of the A. S. M. E.

For its spring meeting at Milwaukee on May 18-21 the American Society of Mechanical Engineers has prepared a tentative program containing a number of papers of interest to electrical engineers.

On Tuesday, May 18, three papers on hydro-electric topics and three on pulverized coal will be given. These are: "The Parallel Operation of Hydro and Steam Plants," F. A. Allner; "Mechanical Features Affecting the Reliable and Economical Operation of Hydro-Electric Plants," E. A. Dow; "Mechanical Problems of Hydraulic Turbine Design," William M. White; "A Microscopic Study of Pulverized Coal," L. V. Andrews; "Radiation in the Pulverized-Fuel Furnace," W. J. Wholenberg and D. G. Morrow, and "Boiler Furnaces for Pulverized Coal," A. G. Christie.

On Wednesday, May 19, there will be four papers on handling materials and two on industrial power, the latter being "Torsional Vibrations and Critical Speeds of Shafts," by A. Lack, and "Tests of a Uniflow Engine," by G. H. Barrus.

On Thursday, May 20, steam power will be the general topic covering the following papers: "Analysis of Power-Plant Performance Based on the Second Law of Thermodynamics," W. L. DeBaufre; "A Review of Steam-Turbine Development," Hans Dahlstrand; "Rational Design of Covering for Pipes Carrying Steam up to 800 Deg. F.," W. A. Carter and E. T. Cope; "Lake Water for Condensers," A. G. Christie, and "Comparison of Actual Performance and Theoretical Possibilities of the Lakeside (Milwaukee) Station," M. K. Drewry.

Expansion Plans of Utilities Power & Light

H. L. Clarke, president of the Utilities Power & Light Corporation, which, with headquarters in Chicago, controls the Eastern New Jersey Power Company, Atlantic Coast Transportation Company, Electric Power & Light Company of Hightstown, N. J., Jamesburg (N. J.) Electric Company and the Colonial Gas & Electric Company of Newport, R. I. has announced that the corporation has acquired control of the Clinton Gas & Electric Company, which supplies electric light and power and gas to Clinton, Iowa, and sells electrical energy wholesale to three other utility companies serving towns and villages in Iowa and eastern Illinois.

Mr. Clarke also made public details of a plan whereby the Clinton Gas & Electric Company will be tied in by high-tension transmission lines with the two large electric power systems of the Utilities Power & Light Corporation in the Middle West—the Interstate Power Company and the Dubuque Electric Company—and these two properties, now largely interconnected, will be completely joined. This means that the electrical energy generated by each of the corporation's properties will be made available in four states—Minnesota, Iowa, Wisconsin and Illinois. To aid in carrying out the plan a large central-station plant will be built at Clinton, Iowa, and the present plant at Dubuque will be enlarged. The Clinton plant will have two 20,000-kw. units to start with and a new 20,000-kw. unit will also be installed at Dubuque. Detailed plans have not yet been completed, according to J. N. Canavan, managing engineer of the Utilities Power & Light Corporation.

National Fire Protection Association Meets May 12

The annual meeting of the National Fire Protection Association is to be held at the Congress Hotel, Chicago, on May 12-14. At this meeting the association's electrical committee, now functioning as a sectional committee of the American Engineering Standards Committee, will present extensive revisions and amendments to the National Electrical Code. The changes in the 1923 code which this report proposes are principally in the direction of securing further safeguarding against injury to persons and against fire hazards in extra-hazardous locations.

The sectional committee is recommending that the National Fire Protection Association adopt its amendments to the 1923 National Electrical Code, and the early publication of a revised or 1925 edition of this is to be submitted to the American Engineering Standards Committee for indorsement as an "American standard" prior to publication.

Operation in Mexico

Troubles of Jalapa Plant as Depicted by American Manager—Why State Seized It

THE Mexican Foreign Office has assured the United States Ambassador that the plant of the Jalapa Railroad & Power Company, which is owned by Americans and was recently seized by the state government of Vera Cruz, after W. K. Boone, the American manager, who has lived in Mexico for twenty-seven years, left the city, will be returned to the owners as soon as they send a fully accredited representative to Jalapa prepared to resume the operation of the plant. The company supplies Jalapa with light and power and operates a trolley line.

The Foreign Office note, quoting reports of Governor Jara of Vera Cruz and of a commission of Jalapa workmen, declares that the government's temporary taking of the property was justified because Mr. Boone left no one in charge and the state could not permit its abandonment. Referring to reports that the manager's life was in danger as a result of the labor dispute that brought about the situation, the note said that he could have requested protection of the federal government. Workmen are said to have demanded wage increases of 150 per cent, and it is further asserted that the state and municipal administrations owe the company $250,000 for energy furnished them.

EXCESSIVE TAXATION

Mr. Boone, who is now in New York, said to a representative of the ELECTRICAL WORLD that it had become impossible to operate the plant any longer under present conditions. The company must pay taxes of 25½ per cent of its gross income in cash, while the debt of the state and local governments just referred to has been accumulating for eleven years. Only about one-third of the energy distributed is paid for, and very recently "consumers' syndicates" have been formed whose announced determination is to pay no more electric service bills until the service is improved. These syndicates are recognized by the state government, Mr. Boone says, in the same way that "renters' syndicates," which have paid no rent in in the last four or five years, have been recognized. With income cut down and taxes raised, it is impossible to consider the additional investments necessary to improve the service, and it is virtually impossible to operate the property. Mr. Boone stated further that there had been several persons killed or injured in recent labor disputes and that his own life had been threatened by workmen in the course of a conference with state and municipal authorities, with no protest from the latter. For three months, Mr. Boone says, he was unable to visit the plant outside of the city because of an announced intention by workmen to kidnap him and hold him for ransom.

Newspaper dispatches say that Ambassador Sheffield will leave Mexico for the United States on May 23 to confer with the Washington authorities on various matters, of which the Jalapa incident is believed to be one.

Governor Again Denounces Ohio Utilities Commission

Governor A. V. Donahey of Ohio has again denounced the State Senate for its refusal to confirm his two nominees for the Public Utilities Commission. In vetoing the Lipp bill, which would have restored to the commission control over its own appointees, the Governor on May 3 charged that the leaders of the General Assembly, with the assistance of certain politicians and representatives of utilities, had combined to thwart him. "Scores of millions of dollars in additional taxes were saddled upon the people," he declared, "not to mention prospective increases in utility rates, as a result of the unholy alliance to defeat confirmation of my appointments, to repass thirty-four bills over my veto and to pass certain other new measures demanded by minority groups. A curb must be placed on the powerful sway of that cankering sore in the state government of Ohio, the Public Utilities Commission, as now constituted, viewed as it is with suspicion, distrust and anger by the vast majority of our people."

As reported in the ELECTRICAL WORLD of April 18, Governor Donahey previously had made a radio address in which he accused the Ohio Power Company and telephone interes... of attempting to defeat his nominees for the Public Utilities Commission.

Briefer News

Atlanta to Have Electrical Show.—The Atlanta Electrical Association will conduct an elecrical show during the period of May 14 to 23. A store in the business district of the city has been leased for the exhibit, and R. H. Scott, president of the association, is in charge of arrangements.

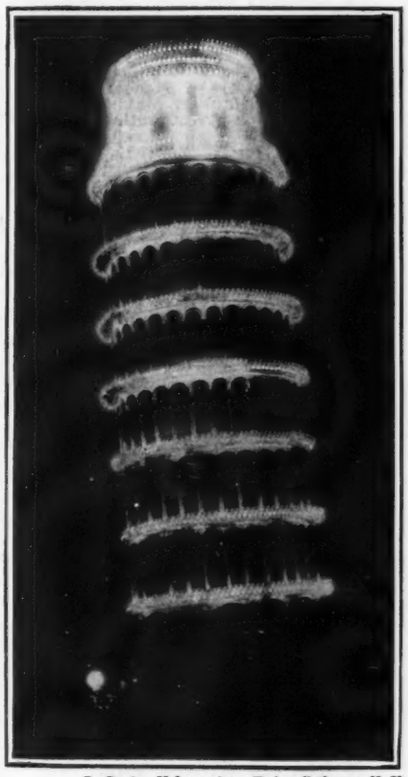
Colorado Public Service Company's Proposed Franchise Disapproved.—The committee appointed by the Denver Chamber of Commerce to examine the proposed franchise of the Public Service Company of Colorado, to be submitted to the voters of Denver on May 19, has reported that in its opinion the franchise is ambiguous and incomplete, and the voters are asked to reject it.

Japan's New Law Governing Generation of Electricity.—A law recently passed in Japan which has attracted attention among American electrical manufacturers is one which requires all hydro-electric plants hereafter to produce by steam at least 10 per cent as much energy as they produce by water power. This law will obviously necessitate considerable construction work in the addition of steam equipment.

Oklahoma to Fall in Line for Rural Service.—A farm electrification conference has been called by the Oklahoma Utilities Association to meet in Oklahoma City on May 18. Representatives of electric utility companies, farm organizations, the Agricultural and Mechanical College at Stillwater, the State Board of Agriculture, farm newspapers, electrical manufacturers and others interested will participate. Dr. E. A. White of Chicago, who is in charge of the national movement, will be present.

Memphis Light & Power Absorbs Two Small Plants.—The Tennessee Railroad and Public Utilities Commission has approved the purchase of the South Memphis Light & Traction Company and the South Memphis Land Company power plants for approximately $145,000 by the Memphis Light & Power Company. South Memphis is not part of the city of Memphis proper, being outside the corporate limits.

Illuminating the Leaning Tower of Pisa.—Reports that the world-famed Leaning Tower of Pisa, Italy, is said by government engineers to be in danger of toppling over unless its slowly increasing degree of inclination is lessened by supporting its masonry base with a foundation lend timeliness to this night view of the tower illuminated by electricity—incandescent lamps being strung where candles were placed during church celebrations in former times.



By Burton Holmes, from Ewing Galloway, N. Y.

Electric Industrial Truck Manufacturers to Meet May 12. — The first regular meeting of the manufacturers of electric industrial trucks and storage batteries will be held at the general offices of the Society for Electrical Development in New York on Tuesday, May 12. As a part of the business development program being carried on by the society in co-operation with this group the manufacturers have decided that a meeting of all members shall subsequently be held on the second Tuesday of each alternate month. Ten manufacturers will participate in this program. R. W. Chandler is chairman.

Nebraska Gas & Electric Buys Humboldt Plant.—Purchase of the electric plant and distribution system at Humboldt, Neb., the transmission line from there to Table Rock and the distribution system in Table Rock by the Nebraska Gas & Electric Company from the O. A. Cooper Company is announced. The purchasing company has for some time been buying energy from the Humboldt plant for the towns of Shubert, Verdon and Stella, which it serves. These towns will continue to receive service from Humboldt.

Ballinger, Tex., Sells Municipal Plant.—The proposal to sell the municipal electric light and power plant at Ballinger, Tex., a town of 3,000 people, to the West Texas Utilities Company for $85,000 was carried at an election just held. The plant will be connected up with the power transmission system of the purchasing company. The West Texas Utilities Company is controlled by the Midlle West Utilities Company of Chicago. Ballinger is served also by the Ballinger Light, Power & Ice Company, controlled by the Interstate Electric Corporation of New York.

Gulf Electric May Purchase Pea River Power Company.—An agreement has been entered into looking to the purchase by the Gulf Electric Company, which is affiliated with the Alabama Power Company, of the public utility properties of the Pea River Power Company, serving a number of southeast Alabama towns, according to a petition filed with the Alabama Public Service Commission by the Gulf Electric Company. Unofficial reports place the purchase price at about $750,000. The Pea River Power Company serves Troy, Opp, Elba, Samson and Brundidge, all in Alabama.

Broad River Power Company Extends Operations.—The Broad River Power Company, the subsidiary of the General Gas & Electric Corporation, which operates in Columbia and Parr Shoals, S. C., has purchased three small properties which will extend its electric light and power system to Johnston and Trenton, S. C. The property at Johnston was purchased from the Johnston Electric Light & Ice Company, the Trenton plant from B. J. Day, Jr., and the transmission system from Johnston to Trenton was purchased from the Bouknight Electric Light Lines Company.

Klamath River Fish Reservation Not Accepted as Final.—California apparently is not through with the Klamath River controversy. The reservation of that stream below the Shasta as a fish and game preserve, approved by the voters last fall, is said to be becoming increasingly unpopular in the northern part of the state, where there is a feeling that this "sportsman's paradise" will militate against the progress of the up-state section. The increasing need for power in the lower Klamath Valley is arousing demands for the repeal of the law. This combined with new proof that the power development need not conflict with the fish industry is possibly paving the way for another test of strength on the matter. The Electro-Metals Company, which holds a preliminary permit for a power project

on the stream, may go into the courts to determine whether or not the new law is retroactive.

Northern New York Utilities Considering New Hydro Plant on the Oswegatchie.—Erection of a 10,000-hp. hydro-electric plant at Rock Dam on the East Branch of the Oswegatchie River, where there is a head of about 110 ft., is under contemplation by the Northern New York Utilities, Inc. This development, which would be between two now existing, at South Edwards and Flat Rock respectively, would employ three distinct falls, Lafarge Falls, Madison Chute and Rock Dam, all included within about one mile and a half. The probable cost of the plant is put at $1,000,000.

United Electric Light Company Looking Ahead.—The United Electric Light Company of Springfield, which expects to have to double the present capacity of its plant before many years, has informed the city authorities of its desire to negotiate for the purchase of a tract of land owned by the city, 100 ft. x 124 ft. in size, on the Connecticut River and adjoining the company's present plant on the north. The company points out that unless it can obtain suitable facilities within Springfield for extending its plant it will be forced eventually to seek a site outside the city limits, thereby depriving the municipality of a source of revenue by taxation.

For a State Technical Institute in New York.—Lewis A. Wilson, director of the division of vocational and extension education in the New York State Department of Education, has prepared a pamphlet on "The Need for a State Technical Institute," the result of ten years' study. The proposed institute would contain departments of industrial information, chemical and physical research, statistical research, factory construction, accounting and business methods, trade and technical training and management training. It would further research work and provide full-time courses of two years or longer, shorter full-time courses, co-operative courses, evening and correspondence courses along technical and trade lines.

East Kootenay (B. C.) Plant on Elk River Completed.—The East Kootenay Power Company, with headquarters at Fernie, B. C., has completed an extensive program of improvement, including its new Elko plant, which generates 15,000 hp. at 6,600 volts, using water under a 192-ft. head on Elk River. This plant makes use of a 1,200-ft. wooden stave pipe 12 ft. in diameter and a concrete-lined water tunnel 2,000 ft. in length and has a concrete-lined surge tank 32 ft. in diameter and 80 ft. high. It brings the company's generating capacity up to 22,200 hp., as the Aberfeldie station on the Bull River develops 7,200 hp. A new transmission line of aluminum wire with steel core, 100 miles in length, in duplication of the present system, has been completed. Altogether the company has 250 miles of transmission lines, and nearly all of its customers have the advantage of duplicate service.

Grand Falls (N. B.) Project Waits Approval of International Commission.—The New Brunswick government has finally passed the bill providing a credit of $9,000,000 for the hydro-electric development at Grand Falls. The bill also provides for the reorganization of the New Brunswick Electric Power Commission. The government's plan is to have two members of the executive council and five outstanding private citizens compose the reorganized commission. The appointments will not be made, however, until an order has been issued by the International Joint Waterways Commission giving the necessary permission for the Grand Falls development. The commission will meet in Montreal May 15, when the application for authority to proceed with the work will be finally dealt with.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see ELECTRICAL WORLD, January 3, page 76.]

American Society of Mechanical Engineers—Milwaukee, May 18-21. C. E. Davies, 29 West 39th St., New York.

Southeastern Water and Light Association—Hotel Patten, Chattanooga, Tenn., May 19-21. W. F. Steigiltz, Columbia, S. C.

Electrical Manufacturers' Club—Hot Springs, Va., May 19-22. S. B. Belden, Jeffrey Manufacturing Co., Columbus, Ohio.

Middle West Division, N. E. L. A.—Hotel Fontenelle, Omaha, Neb., May 20-22. (Conjointly with Nebraska Section.) H. M. Davis, Fraternity Building, Lincoln, Neb.

Georgia Electrical Association—Atlanta, May 21-22. W. W. Barr, Georgia Railway & Power Co., Atlanta.

Electric Power Club—Hot Springs, Va., May 25-28. S. N. Clarkson, B. F. Keith Bldg., Cleveland, Ohio.

American Association of Engineers—Orlando, Fla., June 2-5. C. E. Drayer, 63 East Adams Street, Chicago.

Electrical Supply Jobbers' Association—Hot Springs, Va., June 3-5. Franklin Overbagh, 411 S. Clinton St., Chicago.

Iowa Section, N. E. L. A.—Waterloo, Iowa, June 3-4. H. E. Weeks, 623 Union-Davenport Bldg., Davenport.

National Electrical Credit Association—Atlantic City, June 6-7; Philadelphia, June 8-9. F. P. Vose, Marquette Bldg., Chicago, Ill.

Associated Manufacturers of Electrical Supplies — The Homestead, Hot Springs, Va., June 8-12. F. Nicholas, 30 East 42d St., New York.

Northwest Electric Light and Power Association (Geographic Division N. E. L. A.)—Gasco Bldg., Portland, Ore., June 12. W. A. White, Puget Sound Power & Light Co., Portland.

Pacific Coast Electrical Association (Geographic Division N. E. L. A.)—San Francisco, June 15. S. H. Taylor, 529 Rialto Bldg., San Francisco.

National Electric Light Association—San Francisco, June 15-19. M. H. Aylesworth, 29 West 39th St., New York.

Society for the Promotion of Engineering Education — Union College, Schenectady, N. Y., June 17-20. F. L. Bishop, University of Pittsburgh, Pittsburgh.

National Council Lighting Fixture Manufacturers and National Association of Lighting Equipment Dealers—The Ambassador, Atlantic City, June 17-19. Herman Plaut, 432 E. 23d St., New York.

American Institute of Electrical Engineers—United States Hotel, Saratoga, N. Y., June 23-27. F. L. Hutchinson, 33 West 39th St., New York.

Michigan Electric Light Association—Grand Hotel, Mackinac Island, June 25-27. Herbert Silvester, 401 South Main St., Ann Arbor, Mich.

Southeastern Water and Light Association's Program.—A three-day convention of the Southeastern Water and Light Association will be held at the Hotel Patten, Chattanooga, Tenn., on May 19-21. The greater part of the program is taken up with waterworks topics, but two electrical papers are scheduled for Wednesday afternoon, May 20: "Electric Watt-Hour Meters," by R. D. Hilley, General Electric Company, and "How to Sell Electric Ranges," by W. T. Christy of the same company. On Thursday morning E. D. Reed, general superintendent of the Tennessee Electric Power Company, will speak on "Good Will as an Asset in Public Utility Operation."

New England N. E. L. A. Officers.—At the recent annual meeting of the New England Division, N. E. L. A., the following officers were elected for the fiscal year beginning July 1: President, F. A. Belden, Boston; vice-president, W. P. Schwabe, Thompsonville, Conn.; treasurer, G. M. Guilford, Boston. The executive committee will comprise G. S. Williams, Augusta, Me.; F. E. Webster, Portmouth, N. H.; W. H. Richardson, Brattleboro, Vt.; L. J. Scott, Springfield, Mass.; J. E. Gray, Providence, R. I.; A. J. Campbell, Waterbury, Conn.; F. H. Smith, Worcester, Mass.; G. H. Cox, Boston; C. B. Burleigh, Boston; F. S. Price, Boston, and A. J. Hixon, Boston. Chairmen of sections elected are: Accounting, W. D. Dyer, Boston; Commercial, P. J. Wilson, Lowell, Mass.; Public Relations, H. L. Harris, Boston; Technical, G. M. Hardy, Worcester. A sketch of President-elect Belden appeared in the ELECTRICAL WORLD of May 2, page 944.

Consolidation of Companies in Northern Maryland Sought.—The Maryland Public Service Commission has before it an application from the Northern Maryland Power Company for authority to acquire the properties, rights and outstanding stocks of the Elkton Electric Company, the Havre de Grace Electric Company, the Northern Maryland Electric Company of Baltimore and the Home Manufacturing Light & Power Company of Elkton. In addition the company seeks approval of the acquisition by the Eastern Power Company, a Delaware corporation, of stocks and bonds of all the other companies mentioned in the application. The Northern Maryland Electric Company and the Belair Electric Company had filed protests with the commission against an application from the Consolidated Gas, Electric Light & Power Company of Baltimore for leave to extend its lines into Harford County. Subsequently the Consolidated Gas made application for permission to purchase the entire stock of the Belair company, and the Northern Maryland company protested against the application of the Belair company to construct a transmission power line from Churchville to a point near Aberdeen. The territory in dispute is adjacent to the site of the projected Conowingo hydro-electric development.

Men of the Industry

Samuel Hutchinson of Kansas City, Mo., has been appointed a member of the Missouri Public Service Commission by Governor Baker to succeed R. H. Musser of Plattsburg.

George F. Maddock, for many years associated with H. M. Byllesby & Company of Chicago and more recently in charge of land reclamation work for J. Ogden Armour in the Sacramento Valley, Cal., has joined the engineering staff of A. E. Fitkin & Company, public utility operators, New York.

William W. Tefft has been made vice-president of the Consumers Power Company, Jackson, Mich., chief engineer of the Consumers Power Company and chief engineer of the Commonwealth Corporation of Michigan. He is also chief engineer of the Central Illinois Light Company, Peoria, Ill.; the Southern Indiana Gas & Electric Company, Evansville, Ind.; the Illinois Power Company, Springfield, Ill.; the Ohio Edison Company, Springfield, Ohio, and the Illinois Electric Company, Peoria, Ill.

R. H. Ballard, executive vice-president and general manager of the Southern California Edison Company, Los Angeles, is sailing from New York today (May 9) on the S. S. *Olympic* of the White Star Line. With Mrs. Ballard, he will tour Europe on what will be the first real vacation which he has had in some time. Ever since he was president of the National Electric Light Association the business and building programs of the Southern California Edison Company have kept Mr. Ballard pretty close to his desk.

W. V. Patton, who for the past few years has been connected with the Puget Sound Power & Light Company at Everett, Wash., has been appointed local manager at Edmonds to succeed V. P. McNamara, recently transferred to Everett.

Arthur Miller has been appointed manager in Cleveland of the Ivanhoe division of the Miller Company, Meriden, Conn. Mr. Miller has been in the lighting industry since 1907. For several years he was city salesman for Ivanhoe in New York City, and in April, 1922, he took charge of the New York State territory. One year later he was made district sales manager of the Eastern section of the United States, subsequently being appointed acting manager of the Ivanhoe division.

Paul Butler of Harris & Butler, Philadelphia, will shortly join the New York office of the Delta-Star Electric Company. Mr. Butler's association with Harris & Butler, covering a period of approximately eighteen years, eminently qualifies him for his new position. Previous to his connection in Philadelphia he was district manager of the Pittsburgh Transformer Company in New York.

E. J. Nieder has been placed in charge of the electric truck bureau recently installed by the Cleveland Electric Illuminating Company in Cleveland to co-operate with local business houses in solving their transportation problems. In preparation for his new position Mr. Nieder has spent considerable time in studying transportation methods and delivery systems.

E. W. Payne has been elected to the directorate of the Illinois Power Company, Springfield, Ill., to succeed the late Major Bluford Wilson.

J. M. Gibson has been appointed director of education and personnel for Charles H. Tenney & Company, Boston. Mr. Gibson will continue to edit the *Tenney Service Magazine*, published by this organization for officers and employees of utilities under Tenney management.

Ralph W. Coffin, formerly superintendent of the Cape & Vineyard Electric Company, with headquarters at Bass River, Mass., has joined the sales staff of the R. H. Booth Sales Company, Boston, representing the Socold Electric Refrigerating Company, Lynn, Mass.

C. H. Hardesty, traffic manager of the Monongahela-West Penn Public Service Company, has been appointed acting manager of the Parkersburg-Marietta division to succeed Henry S. Newton, recently placed in charge of the new industrial department. Mr. Hardesty has been traffic manager for the past four years and has been an employee of the company since 1917.

George Hibbert, Jr., for the past eight years associated with the Astoria office of the Pacific Power & Light Company, has been advanced to the position of manager of the Toppenish district.

A. B. Cayo, for many years in the overhead distribution department of the Portland Electric Power Company, Portland, has recently been appointed assistant superintendent in that department.

E. R. Acker has joined the general commercial staff of the Central Hudson Gas & Electric Company at Poughkeepsie, N. Y., as assistant to the general commercial manager, L. P. Perry. Mr. Acker was formerly general superintendent of the Central Hudson system at Kingston.

W. E. Thurman has been appointed manager of the Canadian General Electric Company, Ltd., at Edmonton, Alberta, succeeding Norman Franks, recently transferred to Winnipeg.

C. C. MacMahon, acting superintendent of transportation of the Commonwealth Edison Company, Chicago, has been appointed superintendent of transportation. Mr. MacMahon has been connected with the company's transportation work throughout his seventeen years of service.

Fred H. Simmer has been appointed on the staff of resident engineers of the Curtis Lighting, Inc., to serve the Indiana territory, with headquarters in Indianapolis, Ind. Mr. Simmer will represent the company in the entire State with the exception of the extreme northern part. A section of eastern Illinois will also be included in his territory.

F. A. Bird, chief engineer of the Lake Charles (La.) Electric Company, Inc., has recently resigned to devote more time to his personal interests in that city.

Robert Evans has been appointed electrical superintendent of the Santa Rosa plant of the Pacific Gas & Electric Company.

G. H. Sanger, formerly of the Philadelphia office of the Riley Stoker Corporation, has been transferred to the Chicago office, succeeding E. W. Wagenseil, who has resigned to become sales manager of the Buckeye Drier Company.

H. B. Curtis, formerly connected with the Ozark Electric Company, has disposed of his interest in that company to enter the merchandising department of the Southwest Power Company at Fayetteville, Ark.

J. P. Growdon, since January, 1920, electrical engineer for the city of Seattle on the Skagit development, recently joined the Aluminum Company of America, Pittsburgh, as principal assistant hydraulic engineer under James W. Rickey, chief hydraulic engineer.

E. W. Trafford has severed his connection with the Department of Public Utilities, Richmond, Va., and has established offices there as consulting engineer.

Norris R. Sibley, formerly with the Westinghouse Electric & Manufacturing Company, has recently joined the B. F. Sturtevant Company in its sales organization. Mr. Sibley is now in the New York office of the company and has charge of steam turbine sales in that district.

George M. Leach has been appointed division manager of the Atlantic City Electric Company at Hammonton, N. J., succeeding C. A. Berry.

G. D. Anderson, Jr., formerly in the Baltimore office of the Crocker-Wheeler Company, is now associated with the branch recently organized at Atlanta. A graduate of the Georgia School of Technology, Mr. Anderson served in various departments of the company's factory at Ampere, N. J., before joining the Chicago sales staff. From Chicago he went to Baltimore, recently relinquishing his duties there to go to Atlanta.

Obituary

William E. Flowers died in Atlanta on April 25. Mr. Flowers was for twenty years connected with the Southern Bell Telephone & Telegraph Company, but during the last six years of his life he was employed in the engineering department of the Georgia Railway & Power Company.

Harry D. White, who for the past twenty-one years was manager of the Fredericton Gas Light Company and its successor, the Maritime Electric Company, Fredericton, New Brunswick, died April 19 after a stroke of paralysis. Mr. White was one of the pioneers in the electric industry in Canada, having followed the business since 1884, and had a large and varied acquaintance in both the Dominion and the United States. He was sixty-one years of age.

Commission Rulings

Missouri Commission Uses Straight-Line Method to Calculate Depreciation.—In determining the rate base for the Warrensburg Electric Light, Heat & Power Company, now owned by the West Missouri Power Company, the Missouri Public Service Commission rejected the sinking-fund method of calculating depreciation of physical property used by appraising engineers engaged by the company and substituted the straight-line method. The commission cited many important cases in which the same action had been taken throughout the country and stated that the straight-line method is very generally used by most regulating bodies and is the established practice of the Missouri Public Service Commission.

Charter Amendment Involving Competition with an Established Company Is Refused.—Until 1918 the Borough of Bangor, Pa., was served with light, heat and power by the Pennsylvania Edison Company. In that year this company served notice of an increase in steam-heating rates, and as a result a local company, the Bangor Electric Company, was formed to take over the local power plant, serve the power customers only and furnish the town with steam heat from the plant's exhaust steam. This new company was unable to find enough power consumers to make its business profitable, and it therefore applied to the Public Service Commission of Pennsylvania for a certificate of public convenience to serve lighting customers in the territory in which it already furnished power and in which the Pennsylvania Edison Company is chartered to furnish light. The commission has refused to grant the desired permission, stating that "the grant of this certificate of public convenience would introduce into the area a competitive situation which cannot be justified by any policy of utility regulation."

One Power Rate per Kilowatt-Hour Regardless of Consumption Not Approved.—The Orvil Light, Power & Water Company asked the Illinois Commerce Commission to approve its adoption of a fixed charge per kilowatt-hour for power service, regardless of the amount consumed. The commission ordered instead a sliding scale, saying of the company's proposal: "Such a rate does not appear to be well adapted to development of new business, for it offers no inducement to a large user of power, and it is unlikely that such a user would locate along the line or in territory served under a rate of this kind. It is customary, therefore, in constructing a rate for power service, to reduce the rate in each successive block of energy, thereby holding out an inducement to large users of energy and at the same time giving recognition to the fact that by making a more continuous use of the utility's facilities the cost of furnishing the additional service will be reduced."

Rate Base Adopted in 1914 Regarded as Permanent Foundation for Present Rates.—The Maryland Public Service Commission in setting rates for the Chesapeake & Potomac Telephone Company asserted that a rate base established as of June 30, 1914, had been established with the understanding that it was to be permanent and that for the future the fair value of the property for rate-making purposes was to be determined by adding to the base figure the net additions up to any given date less depreciation. The commission thereupon proceeded to dispose of the case on this theory, declaring that it could "not agree with the contention strongly urged by counsel for the telephone company that evidence as to the cost of reproduction presented by it should be given dominant weight in arriving at fair value in this case. The weight to be given the different elements that enter into the determination of fair value may vary widely in different cases, and each case must be decided on the basis of the facts as developed in that particular case." This decision, however, was upset by the United States District Court, as recorded under "Court Decisions" last week (page 946). In the course of the commission's decision reproduction-cost estimates of the value of utility buildings were held to be inaccurate when based on the cubical content of the building, and testimony of this sort was declared to be no more than evidence based on opinion only.

Utilities Must Meet Expense of Moving Lines Where This Is Necessary to Eliminate Grade Crossings.—Holding that it has power to require utility companies to move their poles and lines from one side of a highway to the other at their own expense in order to make room for railway tracks which are to be moved across the road not for the convenience of the company but for the safety of the public through the elimination of grade crossings, the Pennsylvania Public Service Commission ordered the Northwestern Electric Service Company of Erie to move its high-tension line, as well as trolley tracks, poles and wires, from the west to the east side of a highway. A contention of a telephone company to which a similar order was given that the state law cited by the commission did not apply because the reason for ordering the poles and lines moved was to permit another public service company to occupy their site was overruled by the commission.

Central-Station Company Ordered to Serve Municipal Plant.—The New Hampshire Public Service Commission ordered the Laconia Gas & Electric Company to extend its service to the municipal plant of the town of Belmont, which had severed its connection with another public utility. In making this order the commission said: "The Laconia company has general authority to operate as a public utility in the town of Belmont. Since it has this privilege the law imposes upon it the duty to serve, upon reasonable terms, any one in Belmont desiring service. It makes no difference whether the party desiring service be an individual or a corporation, private or municipal, so long as the applicant is willing to pay a reasonable price for it. The utility cannot question the motive which prompts a consumer to desire service of it in preference to obtaining it from some other source. The point is that the one desiring service is willing to meet the reasonable terms of the utility and that, therefore, it is the duty of the utility to furnish it. The reason set forth in the answer of the Laconia company for its unwillingness to serve the district is untenable. However praiseworthy may be the altrustic spirit which prompts its reluctance to take away business from another utility with which it is on friendly terms, this does not fulfill its legal obligation to furnish service upon reasonable terms to any one in its territory desiring it."

Recent Court Decisions

Company Chartered as Railroad Company May Exercise Right of Eminent Domain for Transmission Lines.—The Supreme Court of West Virginia has affirmed a decision of the lower courts in the case of Monongahela-West Penn Public Service Company vs. Monongahela Development Company, that a company chartered as a railroad company but engaged in the operation of electric railways and the generation and distribution of electrical energy may exercise the right of eminent domain for transmission-line right-of-way in the same way that companies chartered as electric service companies may exercise it. (127 S. E. 23.)*

Cost of Litigation Over Rates a Proper Operating Charge.—The law fixing the price of illuminating gas in Greater New York at $1 per 1,000 cu. ft., which has in decision after decision been found confiscatory as different companies have presented the issue, has been again condemned, this time by the United States District Court in New York, which, approving a report from Special Master James G. Graham in the case of the Consolidated Gas Company, says: "The master's conclusion is that an actual test of the statute [fixing the rate] to demonstrate its confiscatory character is unnecessary. I believe that conclusion to be amply justified by the record. There is no narrow line in this case between confiscation and non-confiscation. I concur in the master's conclusion that the enforcement of the proposed one-dollar rate, if applied to actual operation of the plaintiff during the periods under consideration, 1922-23, would be equivalent to the confiscation of its property whatever rate base be the starting point." The court said that it would have been proper to include in the cost of operation the constantly recurring expenses of rate litigation. This expense, it was pointed out, was eliminated.

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Manufacturing and Markets

A National Service Policy

Great Possibilities for Future Discoveries in Electrical Science, Says G. E. Tripp

"ELECTRICITY has not only brought about the technical possibility of large service systems but it has also brought about an economic need for them, and the outlook for the future is toward still larger organizations and still greater advances in scientific technique. To a rational mind the question is not, 'Do we want large organizations?' but 'What kind of large organizations do we want?'" These statements were made by G. E. Tripp, chairman of the Westinghouse Electric & Manufacturing Company, in an address on "The Future of National Electric Service" delivered at the Southwestern Public Service Association convention at Houston, Tex., on Wednesday.

Continuing, Mr. Tripp said: "We undoubtedly want the kind of organization which will respond the most readily to the advance in science, not only for our own wellbeing as a nation, which persons now living will see possessing a population of 250,000,000, but also that we may keep abreast with a new world which is tending more than ever before toward segregation into national economic units, which will compete with one another, to what ultimate end I make no prediction. There is nothing in history that teaches us nor in human nature which warrants a hope that government organizations will or can advance into new fields of science and industry with the smallest part of the vigor and enterprise of private initiative, which ventures sometimes recklessly and always to the limit of prudence in hope of gain.

"In an art big with unborn achievements, as is the electrical art, the swift and skillful delivery of them far outweighs all questions of rates and returns. These are matters of present-day operations which can be and are administered and surrounded with safeguards under our existing system of regulation; but if through a misconception of the relative importance of these details, the march of national electric service is retarded, I believe a future generation will charge a great mistake against this one.

PRIVATE INITIATIVE ESSENTIAL

"No one knows whither we go—but we do know that science has not changed human nature; it has simply given opportunities for the collective use of human impulses, and the strongest of these is rivalry between groups. When this elementary human attribute is exercised by private groups, it is favorable to the prompt exploitation of new discoveries, and the interests of the people are not endangered because they can be fully protected by the sovereign government.

"But when government itself takes a hand in enterprise, then rivalry tends to disappear, because the citizen cannot compete with his sovereign. That energy which under private initiative forces the adoption of revolutionary discoveries is greatly weakened and progress is retarded. Furthermore, the public has then much less protection, for nothing except the slow-moving force of popular opinion can control the government."

With the great possibilities for future discoveries in electrical science Mr. Tripp pointed out the necessity of such a national policy toward it.

REMARKABLE DEVELOPMENTS FORESEEN

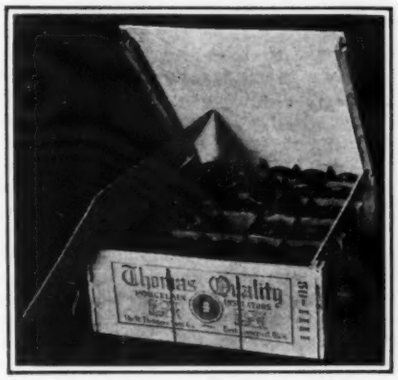
Mr. Tripp in his address also said that he was willing to risk mentioning one or two of the future possibilities in the electrical field, and he compared them with things written by popular authors wholly as fiction, and at the time considered entirely impracticable by the public, but which have since been realized. Mr. Tripp considered the incandescent lamp and called attention to it as the most wasteful and extravagant form of the conversion of electricity into light. He called attention to the fact that J. B. S. Haldane, the great English scientist of the University of Cambridge, said that it was a fairly safe prophecy that in fifty years light will cost about a fiftieth of its preesnt price and there will be no more night in our cities.

The prophecy was ventured by Mr. Tripp that some time, even in the near future, electricity may be produced directly from heat, thus doing away with the steam engine. He also mentioned that there may be soon discovered a cheap foolproof and durable storage battery which will revolutionize the electric light and power industry by making it possible to store electricity in large quantities and for long periods. Other probabilities were also mentioned by Mr. Tripp as conceptions of the imagination.

Progress in Packing Insulators

How the R. Thomas & Sons Company and the Locke Insulator Corporation Have Handled the Problem Presented by Larger Insulator Sizes

IT IS an axiom, but one of which sight is often lost, that the price of an article often does not determine its cost. For in many cases with bulky, fragile or hard-to-pack goods the expense of handling, warehousing and delivering the material to the point of use will put the actual cost of the job considerably above the price at which the material was purchased. Insulators are a good case in point, and it is interesting to note the measures that have been taken by two prominent manufacturers to improve packing practice and reduce the cost of handling both before and after shipment.



THE THOMAS "PACKT-TO-STACK" CARTON SHOWING METHOD OF PACKING INSULATORS

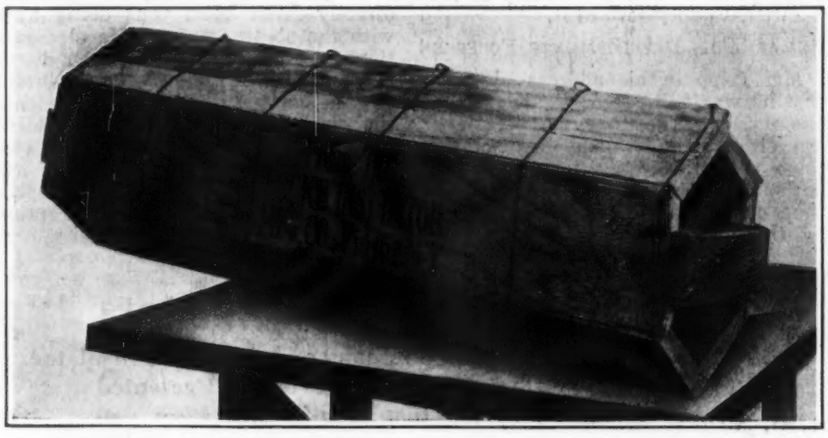
With the continued increase in transmission-line voltages has come a gradual growth in the size of insulators. In the old days it was usual to pack insulators in barrels with a filler of straw or shavings or excelsior to prevent the porcelain or glass from being broken as the barrels were rolled or thrown around in shipment. But as this system became outgrown because of the increase in the size of the insulators crates were developed for both pin-type and suspension units. The first of these crates were bulky and cumbersome, however. They were usually made of 1-in. lumber and carried three to six pin-type insulators and from five to ten suspension insulators. Another difficulty with this slat crate was found as the distances for transporting insulators grew greater, because the cases often weighed as much as the insulators. Of course, during the war these factors became even more important with the added need for the conservation of lumber and shipping space. Manufacturers turned their attention, therefore, to the development of more economical containers.

Corrugated paper cartons were tried but had a very distinct weakness in the shape of inability to withstand the weather. Since a porcelain insulator is to live its life outdoors, it is natural that the average storekeeper will take less pains to get a shipment of insulators in out of the wet than a consignment of lighting fixtures or art glassware. But when a paper carton becomes water-soaked it is done for. It was obviously necessary therefore to work out the problem with wood.

The R. Thomas & Sons Company of

East Liverpool, Ohio, after much experiment, has developed what it calls a "Packt-to-Stack" carton, built along the same lines as an egg crate except that it is made of heavier material, especially as regards the reinforcing members, and that solid panels are used instead of slats. In addition, it s wire-bound. Within the carton each insulator occupies a separate compartment, which not only serves to provide perfect protection to the product but likewise reduces the time necessary to insure a correct count.

These cartons are extremely rigid and strong and will tier solidly and economically, which is of decided advantage in the warehouse. They can likewise be very efficiently handled by the line crew, since they can be carried as units on the service truck and can be distributed most effectively on the iob. Their rigidity and solid packing



HEXAGONAL VENEER CRATE USED BY THE LOCKE INSULATOR CORPORATION

permit of extremely rough handling without damage.

No actual figures on the economies effected are available, but the carton has meant much to the manufacturer. The new carton is stored in knocked-down form and in about one-third the space of a barrel. The field cartons occupy the same space as their equivalent in barrels, but tier better and pack more compactly in large stocks. Less space is now assigned for storage of packing materials and less time is spent in packing and counting. In addition, there is much less uncleanliness in the packing department. The cost curve went up somewhat when this system was adopted, but the sales went up too, for the package has had a distinct sales appeal that has more than justified the added cost.

The Locke Insulator Corporation of Baltimore has adopted a wood-veneer wire-bound box for pin-type insulators, but for the round suspension insulators it uses a hexagonal crate which is "padded" by the use of "skirt cleats" between two strips of veneer that provide unusual protection in either domestic or foreign shipment. The shape gives an economy in warehouse, truck, car or steamer space that is virtually 30 per cent. This hexagonal container has greatly reduced the storage costs of stock boxes and has brought a very worth-while money saving in the cost of transportation by water where the transportation charges are determined not by weight but by cargo space. The advantage to the distributor and the power company that use these insulators and must stock and handle them is apparent.

Rural Electrification

Experiments Made by the University of Wisconsin Show Need for General Utility Farm Motor

AS A RESULT of experiments in rural electrification carried on near Ripon by the University of Wisconsin in co-operation with the public utilities of the state, the experimenters have become convinced of the need for certain changes in farm practice and machinery before electric power can be used efficiently on farms. "The experiments have not reached the point of definite conclusions," Prof. F. W. Duffee of the university said recently. "For example, we have concluded that one of the essentials to success of rural electrification is a general utility motor that can be used for a number of different purposes. At the present time no such motor is on the market, so we have designed one which we believe will answer, and it is being constructed at the university machine shop.

"It differs from the ordinary motor primarily in that the belt connections to other machines have been replaced by shafts and gears, and that the motor will be so equipped as to permit varying degrees of speed and power in the machine operated by the motor. In feed-grinding experiments it was found that a grinder was necessary that would operate with a 2-hp. motor to give the most efficient results. We were able to find such a grinder among the many now on the market, and experiments were conducted at the university with two different makes, both of which proved successful. They are now installed at the experiment station near Ripon, where excellent results are being obtained from one, and results not quite so satisfactory from the other, doubtless due to faulty connections.

"As the result of experiments in grain curing last fall, we are now planning the construction of a hoist to accompany a binder, so that the grain bundles may be lifted direct from the binder to a wagon and then conveyed to a stack, where the grain will be dried by means of forcing air through it with electric power. This method would perhaps be little cheaper on a bushel basis than the old method, but it would be a great advantage to the farmer in that it would save time and distribute labor over a period of time, thus doing away with a great rush at one time. Experiments along these lines are still in their infancy, of course, and will be continued further during the coming season.

"Figures compiled by Paul Nyhus, state agricultural statistician, on the actual extent of rural electrification last June were considerably above the estimate we had fixed. At that time 9,881 farmers were using electricity from transmission lines and 10,249 had their individual generating systems. In one county approximately 25 per cent of the farms were electrified by one or the other methods. Electric ranges, water pumps, milking machines and other farm machines have been installed on the experimental farms near Ripon, and accurate data are being kept constantly in the effort to determine the extent to which electricity can be used on a farm profitably."

Electric Furnace Sales

Central-Station Co-operation Reduces "Overhead" and Helps to Develop Industry

BY EDWIN L. WILLSON
Sales Engineer F. J. Ryan & Company, Philadelphia

THE sales problem of the electric furnace builder is complicated by the fact that, in addition to interesting "prospects," he must be equipped with an engineering organization capable of studying the "prospects' " needs and in most cases spending considerable time and money to make a thorough study of the proposed operation and to recommend changes which will result in the most economical showing. This engineering service on the part of the furnace builder may be rendered absolutely without bias and the recommendations made entirely in good faith, but, as is the case with all free advice, it is naturally somewhat discounted by the "prospect" because it comes from a source which will profit by its adoption.

For each competing furnace builder to develop properly the field in this manner means many duplications of the same work and consequent increase in the overhead cost with no gain to the industry, and, on account of the fact that the furnace builder can make only one profit on the sale of equipment, it is impossible to expend the effort necessary to cover thoroughly all prospective users of electric furnaces. The furnace builder is, therefore, in the position of carrying too large a burden for the sake of the profit to be made on one installation, whereas the central-station company reaps the benefit as long as the equipment is in use, and it would seem that the development of this branch of industrial heating should be undertaken by the central-station companies.

The excellent work in this direction being done by the Edison Electric Illu-

minating Company of Boston we believe is invaluable in this line. We have received numerous data sheets from them showing the results of these surveys, and in every instance our engineering department has been able to make a definite recommendation and prepare an estimate covering the heating equipment without the necessity on our part of spending any time or incurring any expense in surveying the prospective operation. In each such proposal we have been able to quote a lower price on the equipment by virtue of the saving in overhead expense which would have been necessary had the transaction been carried out in the usual manner. We believe that the development of electric industrial heating would be greatly expedited if more of the central-station companies would adopt the plan which has been so successfully developed by the Boston company, under J. L. Faden, its industrial electric heating engineer.

Permanent Lighting Exhibit Opened by Industry Exposition

A MODEL shop installation from a lighting standpoint has been opened to the public on the Boardwalk, in front of the Million-Dollar Pier, at Atlantic City, N. J., by the National Art and Industry Exposition. The lighting plan was designed by a special sub-committee of the lighting committee of the N. E. L. A., composed of Ward Harrison, George H. Stickney and Samuel G. Hibben. This will be a year-round exhibit, according to A. Conrad Ekholm, managing director of the exposition.

As far as the lighting features are concerned, the display takes in store, office and stage lighting. In addition to these features there are also shown three completely furnished rooms of a modern home, including a living room, bedroom and bath. Educational talks on lighting will be given to the visitors.

Business Conditions

DESPITE a slight decline in orders, business is on a good basis. Electrical men are optimistic, and fairly good requests for quotations are reported, with several orders being placed, though they are individually small. Materials are being absorbed in good volume, and the tendency to purchase only for immediate requirements still predominates. A large project planned is that of the Boston Edison company which consists of an 11,000-volt, two-circuit, steel-tower line, 31 miles long, from Weymouth, Mass., to Bellingham, Mass., at an estimated over-all cost of $1,740,000.

Conditions are fundamentally sound, there is no lack of buying power, stocks are adequate but not large, and money is readily available. In view of these conditions the cautious attitude of industry is, if anything, a stabilizing factor. Raw materials are readily available at comparatively low prices. Competition is very keen and has served as an incentive to reduce costs and to accept orders on narrow margins. Indicative of the present situation is the case of a large industrial company which has been in the market for more than $750,000 worth of electrical material for extensions and improvements. Orders for this material are being placed gradually, and much still remains to be purchased. There has been no effort to rush orders to cover, and as a similar attitude prevails among other companies no very large individual orders are being placed.

In New England orders for electrical equipment continue to show a conservative trend, with central-station equipment for replacement and expansion in most active demand. Orders have fallen off in the New York district, but conditions are good and the outlook is satisfactory. Central-station companies are placing the bulk of the orders in that territory, but buying by industrial firms is good. In the Southeast an improvement in the volume of business is noted, and materially better prospects for future business are in sight, especially in the industrial field. The demand for construction materials by central-station companies predominates in that territory. Much central-station apparatus has been purchased in the Middle West, and business continues on a steady basis. On the Pacific Coast it has been predicted that May would mark the beginning of the year's real increase in business. Electric range sales are in very good volume in Seattle.

Metal Markets Inactive—Prices Stiffen with Export Demand

ONLY a moderate business has been transacted in lead and copper and even less than that in zinc and tin. The market has been inactive, but prices of most of the metals have shown slight tendencies to advance owing to better cables from London. Domestic consumers continue to buy only for current requirements.

The volume of sales reported by copper sellers was much less than last week's. Most of the business was done at 13¼ cents delivered, the serious break in the London price last week being responsible for the decline to that level. Brass manufacturers bought moderately on Friday, Saturday and Monday, but on Tuesday and Wednesday have refused to follow the market upward. Sellers have revised their quotations to 13⅝ cents with hardly an exception, but in one or two directions small concessions have been made on a few hundred tons, and only a very small amount has brought the full 13⅝-cent price in the East. A fairly good export demand has resulted in this price stiffening.

NEW YORK METAL MARKET PRICES

	April 29, 1925 Cents per Pound	May 6, 1925 Cents per Pound
Copper, electrolytic	13.65	13.6
Lead, Am. S. & R. price	7¼	7¼
Antimony	11¼	12¼
Nickel, ingot	31	31
Zinc, spot	7.325	7¼–7.30
Tin, Straits	56	54
Aluminum, 98 to 99 per cent	28	28

Base copper price May 6, 1925, 16 cents.

The contract price of the American Smelting & Refining Company continues at 7¼ cents per pound, New York. Sales of lead have been moderate in both the New York and St. Louis markets. The market has been governed more by the fluctuations in London than usual. Consumption of lead during March and April was lower than for the two previous months, but there are signs that the demand will improve. Prices of tin have been governed almost wholly by the activities of London dealers. Zinc sales have been in rather small volume. Galvanizers have bought only a few hundred tons. Some zinc has been sold for export, the slight continual advances in the London price since last week being encouraging and the sole reason for the corresponding advance in the domestic market.

Orders Off in New York District —Conditions and Outlook Good

SALES in the New York district have shown a slight falling off as a whole. There is an optimistic feeling in the entire industry, and it is generally considered that business is on a good basis. Central-station companies are placing the bulk of orders, but buying by industrial firms is good. A copper company has placed several orders for miscellaneous power and distribution equipment, and several orders covering inquiries already made are yet to be placed by this company.

A wire manufacturer reports that while orders have fallen off a little this month, business is good. Fairly good requests for quotations have been received by this company, mainly from electric light and power plants, and although there are no large orders, many small orders have been placed and indications are that buying is for immediate requirements. Another wire company states similar conditions and considers the situation healthy. Stocks are adequate but not large, materials are readily obtainable and comparatively low in price and the product is being absorbed, this manufacturer says. Indications are that railway business, including street railways and the electrification of steam railways, will be large this year. Jobbers state that there is a little improvement in buying, the bulk of the business being obtained from industrial companies. Contractors are purchasing little material. Prices are low in spots.

Much Central-Station Apparatus Purchased in Middle West

BUSINESS continues on a steady basis in the Middle West. Considerable buying of apparatus by the various utility companies was noticed. Among the interesting items appeared nine 3,000-kw., 12,000-volt alternating-current and two 3,000-kw., 33,000-volt alternating-current synchronous converters, with regulating equipment and switchboard, and two 1,500-kw., 12,000-volt and 33,000-volt mercury-arc rectifiers, to be used in the Chicago district. Orders for other equipment valued at $60,000, such as forced-draft fans, turbine-driven boiler-feed pumps, in-

Value of Electrical Exports for March, 1925, Compared with Corresponding Month in 1924

(Issued by Bureau of Foreign and Domestic Commerce)

	March 1924	March 1925
Generators:		
Direct-current:		
Under 500 kw.	$111,435	$86,186
500 kw. and over	81,816	94,383
Alternating-current:		
Under 2,000 kva.	3,860	27,590
2,000 kva. and over	186,426	121,550
Steam-turbine generator sets	4,615	32,721
Accessories and parts for generators	66,042	109,653
Self-contained lighting outfits	44,074	66,311
Batteries:		
Flashlight	69,002	133,185
Other primary	63,610	97,095
Storage	362,583	245,100
Transforming or converting apparatus:		
Power transformers	502,085	99,856
Other transformers	256,669	176,002
Rectifiers, double-current and motor generators, dynamotors, synchronous and other converters	44,606	55,375
Transmission and distribution apparatus:		
Switchboard panels, except telephone	244,546	284,343
Switches, and circuit breakers over 10 amp.	140,148	201,367
Fuses and fuse blocks	23,404	35,094
Watt-hour and other measuring meters	40,431	36,364
Volt, watt and ampere meters and other recording, indicating and testing apparatus	91,679	135,602
Lightning arresters, choke coils, reactors and other protective devices	78,489	44,603
Motors, starters, and controllers:		
Motors, under 1 hp.	132,498	202,617
Stationary motors:		
1 to 200 hp.	339,033	283,222
Over 200 hp.	161,141	73,029
Railway motors	176,268	65,827
Electric locomotives:		
Railway	20,938	23,411
Mining and industrial	12,684	17,716
Starting and controlling equipment for:		
Industrial motors	124,823	94,312
Electric railway and vehicles motors	17,290	4,444
Accessories and parts for motors	217,678	175,431
Electric appliances:		
Electric fans	135,037	167,913
Electric lamps:		
Metal-filament	98,862	102,119
Other electric lamps	19,447	27,084
Flashlights	56,335	110,480
Searchlights and projectors	36,043	44,231
Motor-driven household devices	$75,490	100,137
Domestic heating and cooking devices	116,466	94,188
Industrial electric furnaces and ovens	15,088	31,121
Therapeutic apparatus, X-ray machines, galvanic and faradic batteries, etc.	89,516	127,261
Signal and communication devices:		
Radio apparatus	288,812	604,769
Telegraph apparatus	13,739	44,353
Telephone apparatus:		
Magneto telephones	5,509	16,216
Other telephones	49,194	49,681
Telephone switchboards	234,804	142,995
Other telephone equipment	154,491	455,934
Railway signals, switches and attachments	95,953	75,782
Bells, buzzers, annunciators and alarms	7,901	19,209
Other electric apparatus:		
Spark plugs, magnetos and other ignition apparatus	146,404	160,461
Insulating materials	128,721	113,561
Metal conduit, outlet and switchboxes	36,657	57,947
Sockets, receptacles and lighting switches	117,163	132,094
Electric lighting fixtures, interior and street	42,214	108,520
Other wiring supplies and line material	114,307	80,713
Other electrical apparatus	772,770	572,864
Globes and shades for lighting fixtures	37,931	44,355
Electrical glassware, except for lighting	20,343	20,627
Electrical porcelain	227,713	(†)
For less than 6,600 volts	(*)	121,758
For 6,600 volts and over	(*)	42,341
Electrical carbons, carbon brushes and electrodes	256,795	(†)
Electrodes for electric furnaces	(*)	77,894
Other carbon products	(*)	202,342
Insulated wire and cable (iron and steel)	33,461	32,355
Other manufactures of aluminum	125,663	137,824
Copper, bare wire	113,736	235,065
Copper, insulated wires and cables	288,472	408,805
Total electrical machinery and apparatus and supplies	$7,572,910	$7,720,406

(*) Not separately stated prior to Jan. 1, 1925.
(†) Discontinued beginning Jan. 1, 1925.

duced-draft fans and surface air-cooled units, were placed this week. Construction work by central-station companies continues active and maintenance purchases are large.

Jobbers' sales are normally good. The cool period following an unusually hot day has retarded fan sales, which opened up conspicuously last week. Appliance sales have been rather good, with a little stimulation in radio. Wire and conduit have moved briskly. Prices remain generally firm, with a firmer tendency in metals.

Improvement in the Volume of Business Noted in Southeast

IMPROVEMENT in the volume of business is noted in the Southeast, and materially better prospects for future business is in sight, especially in the industrial field. There are several excellent textile-mill projects which will be closed very shortly. Activities in the marble and stone lines are on the increase, with a decided tendency on the part of these industries to consider electrification as a means toward effecting operating economies. Central-station purchases continue to be very much in evidence, with the demand for construction materials predominating. The larger portion of the orders are coming from Florida and Alabama. Building permits issued in this section are high, and a heavy construction program is under way all over the state.

Sales of socket appliances are somewhat slow, but some orders from central-station companies were received. All the larger utility companies are actively pushing the sale of electric ranges, and the results of spring campaigns should be very satisfactory. Washing machines, which have always been slow sellers in the Southeast, are increasing in popularity, owing to intensive sales efforts on the part of manufacturers and central-station companies. Street-lighting equipment, particularly the ornamental type, continues reasonably active, and a number of worth-while jobs are pending.

Cautious Buying in New England —Central Stations Most Active

ORDERS for electrical equipment continue to show a conservative trend throughout New England. Central-station equipment for replacement and expansion appears to be in most active demand. Two 1,800-hp. waterwheels have been ordered from Smith-Morgan Company by the Cumberland Light & Power Company for its Gorham plant. The generators for these units will be furnished by the Allis-Chalmers Manufacturing Company. The Boston Edison company plans to build a 110,000-volt, two-circuit, steel tower power line, 31 miles long, from Weymouth to Bellingham. The estimated over-all cost, including the right-of-way and two 2,000-ft. river crossings, is $1,740,000. Supply dealers see little change from the dull business trend of the past few weeks. On the other hand, one jobber reports an encouraging volume of sales for April with favorable tendencies for May to date. Another jobber reports a steady movement in pole-line supplies, with wire, cross-arms, fiber conduit and insulators in good demand. The sale of about fifteen carloads of line material is reported by another jobber.

The sale of three 2½-ton electric delivery trucks is reported by the Walker Vehicle Company as completing a fleet of this type numbering nineteen trucks. Much interest is displayed in electric heating furnaces and many inquiries are being received. A recent installation of one of these is reported for Holyoke by the American Metallurgical Corporation.

Sales on Pacific Coast Expected to Show Increase in May

ON THE Pacific Coast business so far this year has been very good from industrials and railroads, good from power companies, exporters and contractors, and fair from dealers. It has been predicted that May would mark the beginning of the year's real business increase. The value of building permits issued in April was very good, especially in San Francisco and Seattle. At present contractors report business as rather slow. Jobbers' orders are few and light, but country dealers' stock orders for May 1 shipment showed an encouraging increase over April, especially in the Sacramento and Stockton districts. Conduit, fuses and rural telephones are moving well, and it is said that there is not an available foot of ½-in. flexible metallic conduit on the Pacific Coast.

Among the special orders reported are many for poles. These covered four carloads of 45-ft. poles and 800 poles in 20-ft., 35-ft. and 40-ft. lengths. A cement plant placed an order for $2,500, covering pole-line hardware, construction tools and 60 miles of iron wire, and a northern California lumber company placed an order for the same amount of 2½-in. conduit and No. 2/0 D.B. stranded 2,300-volt rubber-covered wire. Household appliance sales are better, and dealers report that a good proportion of long-pending orders have been closed during the past month. Range sales are in very good volume in Seattle. The lumber market is unstable, and mills are operating at present on a four-day week, with prospects of a shutdown during June. The city of Seattle has awarded a contract for fifteen 10,000-kva. outdoor-type transformers and 100,000 lb. weatherproof copper wire.

Activities of the Trade

American Steel & Wire Entertains New England System Operators

The American Steel & Wire Company, Worcester, Mass., entertained about seventy members of the System Operators' Club of New England on April 29 at its local plants, the meeting including an inspection of the Grove Street museum of the wire industry and a trip through the new paper-cable factory and other departments of the South Works in Quinsigamond. Luncheon was served at the South Works assembly hall, and motion pictures were shown of a recent cable-laying job in San Francisco Bay. C. F. Hood, superintendent of the plant, gave a talk on insulated cables.

Brown-Boveri Directors Here to Study Manufacturing Facilities

Two directors of Brown, Boveri & Company, Henri A. Naville and Jan J. Elink Schuurman, arrived in New York last week to investigate the facilities of American plants that are under consideration for manufacturing its products. They will at the same time study further the possibilities of the American market and inspect installations of Brown-Boveri equipment already made in this country. The directors state that with the rapid growth of the company's business in this country it has become necessary to make proper provisions to take care of the demand. In the course of a few weeks the company will make a definite announcement as to its plans.

Cramp & Sons Report 1924 Good with Better Prospects This Year

The varied activities of the William Cramp & Sons Ship & Engine Building Company enabled the company to show a substantial profit for 1924 with excellent prospects for increased business in every department during 1925, according to the annual report submitted to the stockholders on April 30 by President J. Harry Mull. The I. P. Morris Department operated throughout the year with a fair amount of business in the construction of machinery for a number of the prominent hydro-electric developments in the country. It is believed that during the coming year a volume of business as great as at any time in the history of the company may be anticipated in this field. The Pelton Water Wheel Company has been operated at full capacity for the year, meeting the demand for hydraulic machinery on the Pacific Coast. The facilities of the Pelton company's plant in San Francisco have been largely augmented and improved by rearrangement and the construction of new buildings.

The De La Vergne Machine Company, which specializes in the design and construction of oil engines and refrigerating machinery was fairly busy during the year. Many innovations have been developed in the art of oil-engine design, and the benefits of considerable experimental and research work undertaken during recent years are being felt. The bookings for De La Vergne products increased rapidly during the latter months of 1924, and the prospects for working to capacity during the year 1925 are good.

Link-Belt Silent-Chain Drives Now Available from Stock

The Link-Belt Company of Indianapolis, Chicago and Philadelphia has announced that after many years of work and study of the problem of standardizing and manufacturing silent-chain drives for stock it has placed in operation a new plan by which complete lines of silent chain drives of from ¼ hp. to 10 hp. in virtually any reduction from one to one to seven to one, are now available for immediate delivery by distributors in many principal cities of the country. Back of these distributors the company will carry immense stocks in reserve in the warehouses of the factories at Indianapolis and Philadelphia.

Allis-Chalmers Tractor Business Small Part of Company's Activities

Articles which appear in the newspapers describing the activities of the Allis-Chalmers Manufacturing Company, Milwaukee, occasionally refer to the company as a manufacturer of agricultural machinery among other products and give the impression that such machinery is one of the chief products of the company. The company does manufacture a line of tractors whose principal field is for agricultural use, but they are also sold to other lines of industry. The tractor department was added about nine years ago, long after the original organization of the company.

The engineering and commercial organization of the company is divided into the following departments, each department having its own manager and engineering specialists: electrical, steam turbine, pumping engine, engine, mining machinery, crushing and cement machinery, hydraulic turbine and centrifugal pump, flour-mill and sawmill machinery and tractor departments.

International G. E. Gets Turbine and Generator Orders

Another 35,000-kw. turbo-generator has been ordered by the Toho Electric Power Company of Japan from the International General Electric Company. This is the third similar unit purchased from the company and will be installed in the Nagoya station.

The company has also received an order from the São Paulo Tramway, Light & Power Company of Brazil for two horizontal waterwheel generators rated at 28,050 kw. each. In addition to the generators the order calls for seven 11,000-kva., 88,000-11,000-volt, single-phase, 60-cycle water-cooled transformers.

Pelton Company Gets Order for Large Waterwheels

The Pelton Water Wheel Company, San Francisco, has been awarded the contract for two 40,000-hp. impulse turbines which will be installed in the Rio Itapauhau plant of the São Paulo Tramway, Light & Power Company of São Paulo, Brazil. These units will create a new world's record for capacity for an impulse wheel, the former record having been held by a Pelton 35,000-hp. wheel in the Big Creek No. 1 plant of the Southern California Edison Company. Each of the two turbines will operate under a head of 2,230 ft.

Brown-Boveri Sells Arc Rectifiers to Illinois Central Railroad

Two substations for the Illinois Central Railroad electrification in Chicago, with a total rectifier capacity of 6,000 kw., will use 1,500 kw. all-steel mercury-arc rectifiers. This equipment, consisting of four units, has been supplied by Brown, Boveri & Company, 225 West Fifty-seventh Street, New York. The equipment will be supplied from 12,000-volt and 33,000-volt transmission lines of the central-station companies in that district, which will be transformed to the voltage of the rectifier. The rectifier will deliver direct current at 1,500 volts for use on the collector system of the railroad. The company also announces the sale of 1,800 kw. of rectifiers to the Chicago Rapid Transit Company for use in two substations supplying the elevated lines in Chicago.

Okonite-Callender Cable Plant Ready for Production July 1

The installation of machinery under the supervision of Callender's engineers in the new plant of the Okonite-Callender Cable Company at Paterson, N. J., is nearing completion, and the plant will be ready for production by July 1. This plant, the company announces, will be complete in every detail, combining the latest and best practices of this country and Europe together with specially designed Callender machinery.

The new plant will also contain a completely equipped electrical research laboratory. The company states that this research laboratory, together with its engineering department, will be at the service of its customers at all times to assist them in solving their wire and cable problems.

The formation of the Okonite-Callender Cable Company was announced in the September 27, 1924, issue of the ELECTRICAL WORLD. This company will offer to the electrical industry in the United States impregnated paper cables made by the secret processes and under the patents of Callender's Cable & Construction Company, Ltd., London, England.

Archer & Baldwin, Inc., dealers in used steam and electrical power equipment, announce the removal of their

offices from 114 Liberty Street, New York City, to Bound Brook, N. J., where for a number of years they have maintained a warehouse. This change is intended to facilitate shipments and to permit constant supervision of rebuilding operations, besides providing direct contact with stock so as to facilitate immediate reply to all inquiries.

The Star Electric Motor Company, manufacturer of alternating-current and direct-current motors and generators, ventilating and desk fans, Miller Street and New Jersey Railroad Avenue, Newark, N. J., announces the removal of its New York office from 16 Hudson Street to room 323, 30 Church Street, where more adequate quarters have been secured.

The General Electric Company has received an order from the Illinois Power & Light Corporation for early delivery of five turbo-generators, totaling 88,500 kw. in capacity. They are intended for installation in five plants of the company in three states—Illinois, Iowa and Missouri.

The Pullen-Zoll Electric Company, Miami, Fla., manufacturer of "Wrot-iron" fixtures, has completed the manufacture of a giant hand wrought-iron lantern, several feet in height, which is believed to be the largest of its kind ever built. As a counterpart the company has also built what is considered to be the smallest hand-wrought lantern ever forged—one that is easily held within the palm of the hand.

The Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, manufacturer of pole-line hardware, line material, lightning arresters, etc., announces the opening of a branch sales office in the General Motors Building, Detroit, in charge of Harry A. Stone. The company states that this office has been opened to handle better the constantly increasing business in that territory.

Hubbard & Company, Pittsburgh, manufacturers of pole-line hardware, etc., announce that arrangements have been made with the Copperweld Steel Company to fabricate and distribute Copperweld ground rods as one of its standard products.

The Electrical Appliance Manufacturing Company, Waterbury, Conn., has awarded a contract for the erection of a factory building, 54 ft. by 65 ft., one story high.

The One Minute Manufacturing Co., Newton, Iowa, announces that it is now building its "One Minute" washer, model 52. In this machine the action depends on water alone, there being no mechanical contrivance in the tub, thus providing a large washing capacity.

The Reynolds Electric Company, 2650 West Congress Street, Chicago, manufacturer of electric sign flashers, color hoods, traffic controls, etc., has appointed C. O. Terris as sales representative. Mr. Terris will cover the Middle West territory, including Chicago.

The Commercial Engineering Laboratories, Inc., 7511 Kensington Street, East End, Pittsburgh, announces that it has now placed on the market a foot switch for use with call bells, electric locks, automobile stop lights, etc., known as the "X-C.E.L. foot switch.

The Albert E. Mace Company, 93 Heath Street, Roxbury, Boston, has been recently incorporated and has obtained a Massachusetts charter to take over the business of general power-house construction and manufacture of the "Flowrite" condenser-tube nozzles formerly conducted by Albert E. Mace of the Albert E. Mace Company. Albert E. Mace is president and Fred W. Osborn treasurer.

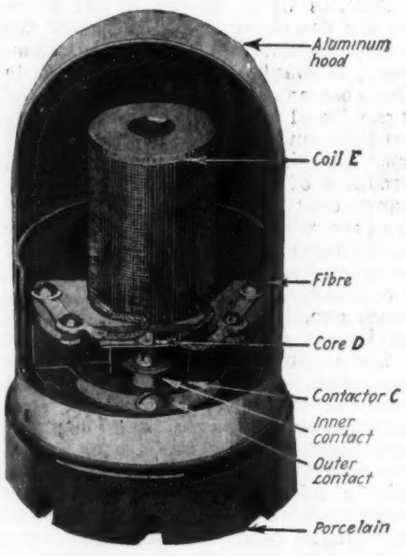
The Chicago Fuse Manufacturing Company, manufacturer of fuses, outlet boxes, etc., announces the removal of its New York office and warehouse to 71 Murray Street, New York City.

New Equipment Available

Multiple-Circuit Street-Lighting System

A street-lighting system adaptable to multiple circuits and known as the "Hood's" multiple street-lighting system has been placed on the market by the Line Material Company, South Milwaukee, Wis. The system uses the existing three-wire, 110-220-volt multiple service with the addition of a control wire energized from a source of approximately 115 volts. The wire can be connected or disconnected at the will of the operator. The contactor, shown in the illustration which is operated between this control wire and the neutral of the multiple system acts as a single-pole switch in one of the outer legs of the three-wire system, the lamps being connected in multiple between this leg and the neutral.

The operation of the contactor, which consumes less than 15 watts when in operation, is such that when the coil is



RELAY-OPERATED CONTROL SWITCH KNOWN AS THE HOOD LIGHTING CONTACTOR

energized the iron core is drawn into the coil and the contact is broken between a bridge and two mercury cups. The breaking of the circuit is actually accomplished between mercury and mercury as the surface of the metal contactor becomes coated with mercury. This results in a new set of contacts each time the switch operates. When the coil is de-energized the circuit is closed as the iron core drops owing to its own weight. The contactor is thus of the circuit-opening type, but it can also be furnished in the circuit-closing type for special cases. The 20-amp. series lamp is used in this system with the addition of small transformers for providing the lower voltage required. If a number of contactors are used on an extended line so that the operation of the further coils would be poor or sluggish, one of the contactors can be connected in cascade to furnish a new source of supply from the multiple system, and this can be repeated as much as desired. This system can also be used in conjunction with an overloaded series system where it is desired to increase the street lighting by installing a contactor of the circuit-closing type in the series circuit.

Rotary Compressor

A rotary compressor for pumping fluids or compressing air and having a special arrangement of the outlet ports which function as a check valve when they do not register or when the fluid or air is not being discharged from the machine has been developed by John Milne, 273 Greenwich Street, New York. The machine is said to be quiet in operation even at high speed. For many purposes it may be used without an air receiver. It is generally motor-driven and does not require the use of unloading devices. The compressor is very compact and simple and has a capacity ranging from ¼ cu.ft. to 10,000 cu.ft. for operation at speeds from 350 r.p.m. to 3,600 r.p.m. for various pressures.

Automatic Calculating Machine.—A new electrically driven automatic calculating machine, designed to operate with the minimum amount of manipulation, has been placed on the market by the Marchant Calculating Machine Company, Oakland, Cal. Among the advantages claimed for this machine are the elimination of zigzag readings of the keyboard, ease in reading the dials, which are concentrated in a limited space, and smooth operation of the carriage. A built-in Westinghouse $\frac{1}{6}$-hp. motor furnishes the power for operation.

Valve Refacer.—A valve refacer using two electric motors instead of one has been placed on the market by the Black & Decker Manufacturing Company, Towson, Md. This design has been followed by the company since the two motors have to do radically different work and operate at different speeds. One of them drives the grinding wheel at 3,450 r.p.m. and the other operates the work spindle through a gear reduction giving the final speed of 430 r.p.m. The use of two motors in this machine eliminates belts or flexible shafts and many wearing parts and also guarantees a more uniform grade of work.

New Trade Literature

AUTOMATIC REGULATORS.—The Arca Regulators Inc. 452 Lexington Avenue, New York City, is distributing a booklet covering the "Arca" automatic regulators (Ragner Carlstedt system) for pressure temperature, humidity, density, vacuum speed, etc. Illustrations are given showing various applications of the regulator, including its use in controlling the power input to an electric furnace. A drawing giving a detailed description of a schematic arrangement is included.

POULTRY TREATER.—Bulletin No. 404 issued by the Cooper Hewitt Electric Company, 959 River Street, Hoboken, N. J., describes and illustrates its "Uviarc" poultry treater, a device developed for the production of ultra-violet light for use in the poultry industry.

GRAPHIC METER.—Bulletin No. 425 issued by the Esterline-Angus Company, Indianapolis, covers the Esterline-Angus new "Twin-Type" graphic meter, in which any two standard meter elements can be built. Several illustrations are included showing various phases of the meter, also a drawing showing the twenty-four and twelve-hour charts used in the instruments.

ELECTRIC DISHWASHER.—"Cleaning Dishes at Less Cost" is the title of a booklet issued by the Crescent Washing Machine Company, New Rochelle, N. Y., in which it describes and illustrates the various types of the Crescent electric dishwashers. It is made in seven sizes having capacities from 1,200 to 18,000 dishes per hour. A page is given to installation and equipment data. It also contains a list of some of the many users of the machine.

DIRECT - CURRENT GENERATING SETS.—Catalog No. 105 issued by the Engberg's Electric & Mechanical Works, St. Joseph, Mich., entitled "Direct-Current Generating Sets," describes and illustrates the Engberg direct-connected, direct-current generating sets for use in all lines of industry. A complete description of the Engberg engine, especially designed and equipped for high-pressure and superheated steam, is included.

FRACTIONAL HORSEPOWER MOTORS.—Bulletin No. 24 issued by the Leland Electric Company, Dayton, Ohio, describes and illustrates the Leland fractional-horsepower motors. A diagram is given showing a characteristic curve of the ½-hp. repulsion-induction, alternating-current, 60-cycle, single-phase, 110/220-volt motor.

AUTOMATIC SWITCHING EQUIPMENT.—The General Electric Company, Schenectady, N. Y., is distributing bulletin No. 67,716-1 describing its automatic switching equipment for outdoor alternating-current reclosing feeder service for 440 volts to 73,000 volts. An illustration showing a typical installation is given and attention is called to the advantages of the use of this type of equipment.

UNDERGROUND CABLE BOXES.—Bulletin No. 25 issued by the G & W Electric Specialty Company, 7780 Dante Avenue, Chicago, describes and illustrates the "G & W" line of underground cable boxes for use in manholes or handholes for interconnecting, sectional, fusing or plain splicing of underground electric cables.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

Purchase is desired in Calgary, Canada (No. 14,760), of 20,000 wood battery separators, and 1,000 battery boxes.

Purchase and agency is desired in Niort, France (No. 14,784), for doctor's and dentist's electrical equipment.

An agency is desired in Berlin, Germany (No. 14,721), for electrical material.

Purchase is desired in Barcelona, Spain (No. 14,764) of electrical materials and machinery and radio sets and parts.

An agency is desired in Genoa, Italy (No. 14,695), for graphite electrodes.

Purchase and agency is desired in Wellington, New Zealand (No. 14,765), for household electrical appliances.

Purchase is desired in Aleppo, Syria (No. 14,762), of household and hospital electrical equipment.

Purchase or agency is desired in Madrid, Spain (No. 14,761), for radio sets and parts.

Purchase or agency is desired in Glasgow, Scotland (No. 14,763), for radio sets and parts.

An exclusive agency is desired in Mukden, China (No. 14,729), for radio and telephone equipment, insulated wire, dry batteries, etc.

Purchase is desired in Copenhagen, Denmark (No. 14,789), of X-ray apparatus.

Purchase is desired in Essen, Germany (No. 14,755), of 100,000 pine telephone poles.

Purchase is desired in Montevideo, Uruguay (No. 14,722), of two electrical cranes.

An agency is desired in Ahmedabad, India (No. 14,772), for oil-burning engines of 4 hp. to 5 hp. and centrifugal and power pumps.

Purchase is desired in Cairo, Egypt (No. 14,723), of a pumping plant for a floating dock.

Purchase is desired in London, England (No. 14,773), of refrigerating plants for household and shop uses.

New Incorporations

THE CHATTACHOOCHIE POWER COMPANY, Opelika, Ala., has been incorporated with a capital stock of $50,000 by J. F. Stallings and F. M. Houston.

THE CAROLINA MOUNTAIN POWER COMPANY, Asheville, N. C., has been incorporated by G. W. Tillett, Jr., and D. W. Spencer.

THE PINNACLE POWER COMPANY, Galax, Va., has been chartered by J. K. Caldwell, president, and N. M. Ward, secretary.

THE SPAVINAW (OKLA.) POWER & ICE COMPANY has been incorporated with a capital stock of $25,000 by W. H. Case and W. E. Kay.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

BOSTON, MASS.—The Edison Electric Illuminating Company has filed plans for the construction of a new operating building at 1131 Massachusetts Avenue, to cost about $100,000.

FALL RIVER, MASS.—The Fall River Electric Light Company plans an interconnection with the Montaup Electric Company this year through a new 23,000-volt outdoor switching station and a 66,000-volt line. H. A. Stanley is superintendent.

SPRINGFIELD, MASS.—The United Electric Light Company plans to build a substation on Wilbraham Avenue, to cost about $150,000. McClintock & Craig, 33 Lyman Street, are engineers.

PROVIDENCE, R. I.—Bids will be received at the office of the Water Supply Board, City Hall, until May 27 for furnishing and installing the following equipment: One 2,200-hp. water wheel; a 1,500-kw. generator; a switchboard; six 22,000/2,300-volt transformers; electric wiring, including duct and pole lines, etc.; a 5-ton and a 20-ton electric crane, to be installed at or near the Scituate dam, now under construction in the town of Scituate, about 10 miles from Providence. Frank E. Winsor is chief engineer. For details see Searchlight Section.

Middle Atlantic States

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company has issued $1,500,000 in bonds, a large portion of which will be used for extensions and improvements, including the installation of a 10,000-kw. generating unit at its plant in Johnson City.

BROOKLYN, N. Y.—Bids will be received by the Bureau of Supplies & Accounts, Navy Department, Washington, D. C., until May 19, for 205 storage batteries for the Brooklyn Navy Yard; for 170 storage batteries for the Mare Island yard (Schedule 3670), for four motor-generators, and three sets of spare parts, for the South Brooklyn yard; and four motor-generators and two sets spare parts for the Mare Island yard (Schedule 3673).

FORT TOTTEN, N. Y.—Bids will be received by the Coast Artillery Corps, Torpedo Depot, until May 11 for 4,920 ft. rubber insulated lead-covered cable (Circular 6).

GLOVERSVILLE, N. Y.—The Public Service Commission has granted the Fulton County Gas & Electric Company permission to exercise franchises in the villages of Schoharie and Middleburgh and the town of Middleburgh. The Fulton County company has taken over the properties of the Middleburgh & Schoharie Electric Light, Heat & Power Company, which was serving these three communities.

NEW YORK, N. Y.—Bids will be received by W. C. Bower, manager, purchases and stores, Michigan Central Railroad Company, Room 344, 466 Lexington Avenue, until June 1, for electric locomotives (Serial Contract No. 12-1925).

NEW YORK, N. Y.—Electric power equipment will be installed in the newspaper printing and publishing plant, to be erected at 71-75 West Street by the New York *Evening Post*, 20 Vesey Street, at a cost of about $2,000,000, for which plans have been filed. Horace Trumbauer, Land Title Building, Philadelphia, is architect.

NEW YORK, N. Y.—Plans have been prepared by the New York Edison Company for remodeling the building at 323-41 Rider Avenue, for an equipment storage and distributing plant, to cost about $100,000. William Whitehill, 709 Sixth Avenue, is architect.

OGDENSBURG, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until May 27 for fire-alarm system, etc., for the St. Lawrence State Hospital, Ogdensburg.

PRATTSBURG, N. Y.—Permission has been granted by the Public Service Commission to the New York Central Electric Corporation, Perry, to erect transmission lines to and install an electric distribution system in Prattsburg.

THIELLS, N. Y.—Bids will be received by the Superintendent of Purchase, Room 106, Capitol, Albany, until May 14 for construction, heating and sanitary work for administration building, officers' cottages "A" and "B" and dining room and kitchen building at Letchworth Village, Thiells.

WATERTOWN, N. Y.—Bids will be received by the City of Watertown, until May 14 for the installation of a street lighting system. P. B. Sutton is city engineer.

WATERTOWN, N. Y.—Authority has been granted to the Northern New York Utilities, Inc., to extend its transmission lines through the towns of Boonville, Western and Lee, and to exercise franchises granted by the three town boards.

CAMDEN, N. J.—Plans are under way to replace all steam-driven apparatus at the Norris water plant of the municipal waterworks with electrical equipment.

PERTH AMBOY, N. J.—The Public Service Electric & Gas Company, Newark, plans to build a combination indoor and outdoor type substation at Mechanic and Pearl Streets, with initial capacity of 3,750 kva. and ultimate output of 20,000 kva.

SOUTH AMBOY, N. J.—The Jersey Central Power & Light Company plans to remove its substation at Fourth Street and Stevens Avenue to another location in the city, where a new station will be built.

CORRY, PA.—Preparations are being made by the Venango Public Service Corporation for the erection of transmission lines to supply electricity in Columbus and Bear Lake. Work has already started on the line to Columbus, which will connect with the Warren-Corry line at Colza. The Colza-Columbus line will be extended east to Bear Lake as soon as possible. If business warrants the transmission will be extended from Bear Lake to Sugar Grove.

PITTSBURGH, PA.—Plans are under way by the Duquesne Light Company for the construction of a substation on Winthrop Street, to cost about $45,000.

PITTSBURGH, PA.—The installation of about 400 additional street lamps in different sections of the city, is under consideration by the City Council. Street lighting service is furnished by the Duquesne Light Company.

READING, PA.—Application has been made by the Metropolitan Edison Company, for permission to acquire and consolidate the systems of the Gettysburg (Pa.) Electric Company, Hanover (Pa) Power Company, and the Cumberland Valley Light &

Power Company, Mount Holly Springs. Extensions to transmission lines and substations are contemplated.

READING, PA. — The Philadelphia & Reading Railway Company, Reading Terminal, Philadelphia, plans to install electric power equipment in connection with extensions to its local locomotive and car shops, including additional buildings. The cost is estimated at $3,000,000.

ELKTON, MD.—Application has been made by the Northern Maryland Electric Company, Baltimore, for permission to take over the Elkton Electric Company, Inc.; the Home Manufacturing Light & Power Company and the Havre de Grace (Md.) Electric Company. Extensions and improvements in transmission lines are contemplated.

BETHANY, W. VA.—Plans are under way by the West Penn Power Company, Pittsburgh, to erect a transmission line from Wheeling to Bethany. At present time electricity is supplied from the Cochran central heating and lighting plant, which belongs to Bethany College. The contract calls for a complete rewiring of the town. When the new line is completed, it is understood, that new electrical equipment will be installed in the various science laboratories and in the shops of Bethany College.

CHARLESTON, W. VA.—Plans for the proposed local synthetic ammonia plant to be erected by Lazote, Inc., Wilmington, Del., at a cost of about $450,000 include a power house.

HARRISONBURG, VA.—Plans are under way for extensions to the municipal electric plant, including the installation of a new generating unit, etc., to cost about $75,000.

LURAY, VA. — Preparations are being made by the Page Power Company to install a 2,200-hp. generating unit to supplement its present 600-hp. unit.

WASHINGTON, D. C.—Bids will be received by the Chief Signal Officer, United States Army, until May 16, for eight motor-generators (Proposal C.P. 20620-3-A) and for 210 cable terminals and 160,000 cable hangers (Proposal C.P. 20951-1).

WASHINGTON BARRACKS, D. C.—Bids will be received by the Quartermaster, Washington Barracks, until May 12, for conduit bodies, covers, bushings, rubber and friction tape, wire, sockets, junction boxes, plugs, staples, fittings, etc. (Circular 10.)

North Central States

DETROIT, MICH. — Arrangements are being made by the city officials to provide more adequate water and railway terminal facilities. Present plans provide for an expenditure of more than $4,500,000 in construction of docks, railroad sidings, power plant and an eight-story warehouse. The first of four such units will be built by the Detroit Railway & Harbor Terminals Company, recently organized.

JACKSON, MICH.—Extensions and improvements contemplated by the Consumers Power Company during 1925 include the construction of a new power house at Otsego to be equipped with two vertical water turbines connected to 850-kw. generators; the present water turbines at the Lowell Dam on the Flat River will be replaced with new units of 600 hp., and other equipment to make the operation of the plant automatic. Test borings will probably be made this year on the Muskegon River at the Ox Bow site for the purpose of determining the location for a dam and power house. Construction of the project will not be undertaken until next year or later. Transmission line construction during 1925 will probably be limited to the completion of the Zilwaukee-Flint 140-kv. line, the erection of the Battle Creek-Kalamazoo 140-kv. line and the section of the Battle Creek-Jackson 40-kv. loop, between Batavia and Cement City. Considerable substation work will be done this year, including a new substation at Five Channels, rebuilding the former Bay City generating plant into a substation. Regulating and switching equipment will be installed in the Atlas substation for supplying power to Atlas and Goodrich. At Owosso the company plans to install new bus and switching equipment and additional regulating apparatus. At Jackson a 6,000-kva. bank of 40,000-volt transformers will be installed, recently removed from Battle Creek. At Lake Odessa the substation will probably be rebuilt. At Kalamazoo complete rebuilding of the bus and switching layout for serving the local load is planned and a 60-cycle, 140-kva. substation will be built. Work at Grand Rapids will include the reconstruction of the Wealthy Avenue substation; a new 1,000-kw. motor-generator will be installed at the Fulton Street plant for supplying additional power to the Edison system. Much work of a minor character is under way.

JASPER, MICH.—A movement has been started by residents of Jasper and Fairfield to secure sufficient subscribers to warrant the expense of the erection of a transmission line by the Southern Michigan Power & Light Company, Hudson, to supply the service here.

PLAINWELL, MICH. — Improvements contemplated by the Eeslay Light & Power Company during this year, include a gradual rebuilding of distribution system, and a separate motor circuit. H. G. Carrow is assistant manager.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until May 15 for furnishing and installing electrical work complete for fire station No. 28.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until May 15 for single-conductor varnished cambric cable for the Division of Light and Power.

SPENCER, OHIO.—Permission has been granted the Cleveland, Southwestern Railway & Light Company, Cleveland to acquire the property of the Spencer Light & Power Company and the Nova (Ohio) Electric Lighting Company.

YOUNGSTOWN, OHIO.—Plans are being considered for renewal of the street-lighting contract. Specifications are being made to include improvements in lighting the main thoroughfares and also a definite system for extending the lighting system to outlying districts.

PEORIA, ILL.—Plans are under way by the Central Illinois Light Company for the construction of a new service and utility building on the river front, to cost about $200,000. In addition to shops, etc., the building will include a garage for its automobiles.

DOTYVILLE, WIS.—Arrangements have been completed by the Wisconsin Power & Light Company, Madison, to extend its transmission line from Dotyville to Osdeola, which will form part of a proposed line to serve the villages of Armstrong, Waucosta and Dundee.

MANITOWOC, WIS. — Petitions have been presented to the City Council requesting the extension of the municipal lighting system to the new limits of the city along North Eleventh Street and the installation of street lamps on North Twelfth Street, between Wisconsin Avenue and the Plank Road.

MOORHEAD, MINN.—At an election to be held May 14 the proposal to issue $135,000 in bonds for extensions to the municipal electric light and power plant will be submitted to the voters.

ONAMIA, MINN. — Arrangements are being made by the Eastern Minnesota Power Company, Pine City for the erection of a high-tension transmission line from Onamia to Isle.

BURLINGTON, IOWA. — Preparations are being made by the Iowa Southern Utilities Company for the construction of a new power plant on the site of the present plant at 115 North Fourth Street, to double the capacity of the present station. Work is under way on the reconstruction of a high-tension line between Burlington and West Burlington, to make connection with the new high-tension transmission line of the Mississippi River Power Company, Keokuk.

CLINTON, IOWA.—The Utilities Power & Light Company, Chicago, has acquired control of the Clinton Gas & Electric Company. The local system will be tied in with the systems of the Interstate Power Company, Chicago, and the Dubuque (Iowa) Electric Company, both controlled by the Utilities company. To aid in carrying out this plan a large power plant will be built at Clinton and the present plant at Dubuque will be enlarged.

MAQUOKETA, IOWA.—The Iowa Electric Company, Cedar Rapids, has acquired a dam site on the Maquoketa River at Canton. The dam will not be built until 1926.

KANSAS CITY, MO. — The Chicago & Alton Railroad Company, 340 West Harrison Street, Chicago, Ill., plans to install electric power equipment at its proposed grain elevator at its East Bottoms yards, to cost about $500,000. R. A. Cook is chief engineer.

CLEARWATER, NEB.—The City Council has entered into agreement with the Tri-State Utilities Company, Minneapolis, Minn., to erect a transmission line to furnish service here. The cost is estimated at about $12,000.

ROSALIE, NEB.—Bids will be received by William Coolidge, village clerk, until May 12 for the construction of a transmission line from Lyons, and for the rebuilding of the local electric distributing system. Grant Fulton & Letton, 525 South Thirteenth Street, Lincoln, Neb., are engineers.

CAWKER CITY, KAN.—The installation of an ornamental lighting system, consisting of twenty-nine standards mounted with lamps of 250 cp., is under consideration. B. Humphreus is manager of the municipal electric plant.

WICHITA, KAN.—The contract for installing electric distributing systems in Isabel, Nashville and Zenda has been awarded to Dwight Chapin, Jr., Wichita. The work includes the erection of 29 miles of 13,000-volt transmission lines, 1½ miles of 2,300-volt lines, a 75-kva. substation in Medicine Lodge, a 30-kva. substation in Isabel, a 22½-kva. substation in Nashville, and a 22½-kva. substation in Zenda, with necessary switching equipment and distribution lines in Isabel, Nashville and Zenda.

Southern States

ROANOKE RAPIDS, N. C.—The Roanoke Rapids Power Company is considering plans for the construction of a 20,000-hp. hydro-electric power plant.

GREENVILLE, S. C. — The Southern Franklin Process Company, contemplates building a steam-operated electric plant in connection with plant at proposed addition to its local mill.

MIAMI, FLA. — The Southern Utilities Company plans to install electric power equipment in connection with extensions at its ice-manufacturing plant, to increase the output from 200 to 350 tons per day, to cost about $100,000.

BIRMINGHAM, ALA.—Application has been made to the Public Service Commission by the Gulf Electric Company, a subsidiary of the Alabama Power Company, to erect a transmission line extending from a point on the hydro-electric system of the Alabama Power system, at or near Union Springs to a point near Troy, a distance of about 33 miles. Authority is also asked to connect this line with the system of the Pea River Power Company, and to construct the necessary substations and appurtenances.

HALEYVILLE, ALA. — The Alabama Power Company contemplates the erection of a high-tension transmission line from the Gorgas-Sheffield line to Haleyville, where it has acquired the municipal electric plant.

ARKANSAS CITY, ARK.—The Breece-White Manufacturing Company plans to install electric power equipment in connection with the proposed rebuilding of its local lumber and woodworking plant, recently damaged by fire with a loss of about $400,000.

FAYETTEVILLE, ARK.—The Phillips Box Company plans to install a power plant in connection with a proposed local mill.

HARRISBURG, ARK.—The property of the Harrisburg Light & Power Company has been purchased by W. G. Tuell and others. Extensions and improvements, including transmission line additions are contemplated.

PINE BLUFF, ARK. — The Arkansas Power & Light Company has applied to the Federal Power Commission for permission to build a hydro-electric plant at Colbert Shoals. The plans provide for a development of 100,000 hp. at a cost of $10,000,000. Ford, Bacon & Davis, engineers, 115 Broadway, New York City, are engineers.

NEW ORLEANS, LA. — Separate bids will be received by John A. Davilla, grand secretary of the Grand Lodge F. & A. M. of the State of Louisiana, 533-535 Iberville Street, until May 23 for the construction of a fifteen-story Masonic Temple as follows: Structural steel, heating, plumbing, ventilation, oil-burning equipment, electrical work, elevators, mail chute, vault door and equipment.

GRANDFIELD, OKLA.—An election will be held May 26 to vote on the proposal to grant the Southwestern Light & Power Company, Lawton, a franchise to furnish electricity here. The erection of 30 miles of high-tension line will be required to reach the city.

PONCA CITY, OKLA.—Bids will be received by C. E. Norton, city clerk, until May 28, for equipment for the municipal lighting plant, including one Diesel engine, about 1,250 hp. capacity, and one 850-kw. generator, 2,300 volts, three-phase, 60 cycles, with accessories.

BALLINGER, TEX. — The proposal to sell the municipal electric plant to the

West Texas Utilities Company, Abilene, has been approved by the voters. Electricity to operate the local system will be supplied from the transmission system of the purchasing company.

Pacific and Mountain States

TACOMA, WASH.—The City Council has authorized the installation of ornamental lamps on a portion of C and Seventh Streets.

OROVILLE, WASH. — The Okanogan Power & Light Company, recently organized, to build a hydro-electric plant in connection with an irrigation project in this section, has applied to the County Commissioners for a franchise to erect and maintain transmission lines over the highways of the county. The company has been granted a franchise to erect lines in Oroville.

SEATTLE, WASH.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 12 for 9,200 ft. of electric cable (Schedule 3687).

SULTAN, WASH.—The Sultan Electric Company has applied to the County Commissioners for permission to extend its transmission lines along a number of county roads. The company is planning to extend its service to several new districts adjacent to Sultan.

WINLOCH, WASH.—Preliminary to rebuilding the transmission lines in the Winlock district the Puget Sound Power & Light Company, Seattle, has secured franchises from the County Commissioners for the use of twenty-one different roads leading in various directions. These lines were originally owned by the Washington-Idaho Water, Light & Power Company, recently acquired by the Puget Sound company.

EL MONTE, CAL.—The installation of an ornamental lighting system on Main Street is under consideration.

SAN FRANCISCO, CAL.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 19 for one central battery central office telephone equipment, complete (Schedule 3669).

SAN FRANCISCO, CAL. — Application has been made to the Federal Power Commission by J. W. Preston, Jr., 350 Post Street, San Francisco, Cal., for a preliminary permit for diversion of waters between forks of Mokelumne and North Fork Calaveras with McCarty reservoir on latter and Bear Creek reservoir on Middle Fork Mokelumne, and to build three power houses on the South and middle forks Mokelumne and north fork Calaveras in Calaveras County.

PHOENIX, ARIZ.—Extensions and improvements are contemplated by the Central Arizona Light & Power Company to its electric and gas systems during 1925, to cost about $500,000. The work will include the reconstruction of the entire transmission line from the plant of the Arizona Power Company in Yavapai County to Phoenix, which is well under way. The capacity of the line connecting with the Water Users' Association is being increased from 3,000 to 6,000 kw.

FAIRVIEW, MONT.—Plans are being considered by the Jennison Light & Power Company, for extensions and improvements in its power plant, including the installation of new equipment, to cost about $50,000. The company also proposes to erect a transmission line to Watford City, N. D., to supply service there.

Canada

CARDSTON, ALTA.—The Town Council has engaged Hadden & Miles, Calgary, consulting engineers, to inspect the municipal electric plant and to investigate several propositions for a new plant.

WINNIPEG, MAN. — Plans are under consideration to extend the system of the Manitoba Power Commission to the Roland District.

ST. JOHN, N. B.—The bill providing a credit of $9,000,000 for the hydro-electric development at Grand Falls has been passed by the New Brunswick government. The bill also provides for the reorganization of the New Brunswick Electric Power Commission.

WELLAND, ONT.—Plans have been prepared for a filtration plant to be equipped with electric pumps, etc., to cost about $300,000. W. Chipman, Mall Building, Toronto, is engineer.

Electrical Patents

Announced by U. S. Patent Office

(Issued April 14, 1925)

1,533,116. ELECTRIC IRON AND STAND; V. G. Jensen, Chicago, Ill. App. filed Nov. 8, 1923.

1,533,117. TOASTER; B. B. Kahn, Hamilton, Ohio. App. filed June 7, 1923.

1,533,153. TELEPHONE-EXCHANGE SYSTEM; S. B. Williams, Jr., Brooklyn, N. Y. App. filed Aug. 17, 1920. Party line working in machine-switching systems.

1,533,154. CIRCUIT-CONTROLLING APPARATUS; S. B. Williams, Jr., Brooklyn, N. Y. App. filed Dec. 18, 1929. For governing the selection of circuits in automatic and semi-automatic telephone systems.

1,533,157. MODULATING METHOD AND APPARATUS; W. E. Beatty, Bayside, N. Y. App. filed Dec. 11, 1919. For modulating alternating currents by means of electron-discharge devices.

1,533,161. AUTOMATIC RESETTING TROLLEY CARRIER FOR ELECTRIC STREET CARS; R. J. Burn, Croydon, near Sydney, New South Wales, Australia. App. filed April 1, 1924.

1,533,163. TELEPHONE-EXCHANGE SYSTEM; H. P. Clausen, Mamaroneck, N. Y., and C. L. Goodrum, New York, N. Y. App. filed Aug. 24, 1920. Circuit arrangement for switches.

1,533,171. TELEGRAPH SYSTEM; A. D. Dowd, Hoboken, N. J. App. filed Oct. 8, 1919.

1,533,175. ELECTRIC HEATING DEVICE; F. A. Fahrenwald, Cleveland Heights, Ohio. App. filed April 6, 1922. Hot plate.

1,533,178. ARTIFICIAL ELECTRIC LINE; J. J. Gilbert, Port Washington, N. Y. App. filed May 19, 1922. For submarine cable systems.

1,533,179. WIRE SWITCH; H. W. Goff, New York, N. Y. App. filed May 11, 1922. Of the co-ordinate type used in telephone systems.

1,533,181. TELEPHONE SYSTEM; C. L. Goodrum; New York, N. Y. App. filed Sept. 8, 1920. Subscriber-controlled machine-switching system.

1,533,182. TELEPHONE-EXCHANGE SYSTEM; C. L. Goodrum, New York, N. Y. App. filed July 26, 1922. Automatic.

1,533,188. AUTOMATIC SWITCHING DEVICE; A. D. Hargan, Bayonne, N. J. App. filed Oct. 8, 1921. As used in telephony.

1,533,192. TELEPHONE-EXCHANGE SYSTEM; C. W. Keckler, Newark, N. J. App. filed Dec. 6, 1919. Manual exchange.

1,533,195. TESTING SYSTEM; E. R. Lundius, Richmond Hill, N. Y. App. filed Dec. 6, 1923. For telephone-exchange system.

1,533,203. TELEPHONE-EXCHANGE SYSTEM; P. B. Murphy, Nyack, N. Y. App. filed April 5, 1921.

1,533,206, 1,533,207. PRINTING TELEGRAPHY; H. Pfannenstiehl, Maplewood, N. J. App. filed July 21, 1920, and Jan. 31, 1923.

1,533,211. STARTING DEVICE; P. M. Rainey, Glen Ridge, N. J. App. filed Sept. 9, 1920. For automatic starting of a La Cour motor.

1,533,223. SYSTEM OF CONTROL; L. W. Chubb, Edgewood Park, Pa. App. filed June 30, 1921. Employed in wireless transmission systems.

1,533,224. ELECTRIC RESISTANCE FURNACE; O. A. Colby, Irwin, Pa. App. filed March 10, 1922.

1,533,225. TEMPERATURE REGULATOR; O. A. Colby, Irwin, Pa. App. filed June 10, 1922.

1,533,226, 1,533,227. STREET-CAR HEATER; O. A. Colby, Irwin, Pa. App. filed Oct. 6, 1922.

1,533,228. ELECTRIC FURNACE RESISTOR SUPPORT; O. A. Colby, Irwin, Pa. App. filed Oct. 24, 1922.

1,533,229. ELECTRIC FLATIRON; O. A. Colby, Irwin, Pa. App. filed Oct. 24, 1922.

1,533,230. ELECTRIC SOLDERING IRON; O. A. Colby, Irwin, Pa. App. filed Nov. 3, 1922.

1,533,231. ELECTRIC FURNACE RESISTOR; O. A. Colby, Irwin, Pa. App. filed Dec. 2, 1922.

1,533,232. ELECTRIC FURNACE; O. A. Colby, Irwin, Pa. App. filed Dec. 2, 1922. Resistance type.

1,533,233. AUTOMATIC CUT-OUT FOR ELECTRIC IRONS; L. N. Crichton, Edgewood, Pa. App. filed Sept. 23, 1921.

1,533,237. BRUSH HOLDER; J. V. Dobson, Wilkinsburg, Pa. App. filed July 19, 1924. Of the box type.

1,533,239. ORNAMENTAL ARC WELDING; O. H. Eschholz, Wilkinsburg, Pa. App. filed Sept. 8, 1920.

1,533,240. HOT TABLE; F. F. Forshee, Mansfield, Ohio. App. filed Oct. 2, 1922.

1,533,241. TOASTER HEATING UNIT; F. F. Forshee, Flint, Mich. App. filed Oct. 4, 1922.

1,533,242. METHOD AND APPARATUS FOR PREVENTING ARMATURE COIL HEATING; C. LeG. Fortescue, Pittsburgh, Pa. App. filed Aug. 8, 1919. To prevent the continual short-circuiting of any one armature coil during the time that the armature winding is at standstill but energized with full-load voltage.

1,533,246. COMMUTATOR SOLDERING IRON; H. A. Hands, Wilkinsburg, Pa. App. filed Sept. 16, 1922.

1,533,247. ELECTRIC HEATING SYSTEM; H. A. Hands, Swissvale, Pa. App. filed Nov. 14, 1922. Temperature-control system.

1,533,251. ELECTRIC SWITCH; H. H. Johnston, Forest Hills Boro, Pa. App. filed June 5, 1922. Means for extinguishing arcs that are formed across a pair of relatively movable contact members.

1,533,253. SLIP REGULATOR; H. A. Lewis, Norristown, Pa. App. filed Aug. 28, 1922. Liquid rheostat.

1,533,254. ELECTRIC FURNACE RESISTOR; G. M. Little, Pittsburgh, Pa. App. filed Jan. 25, 1922.

1,533,255. ELECTRIC FURNACE; G. M. Little, Pittsburgh, Pa. App. filed Nov. 1, 1922. Resistance type.

1,533,258. ELECTRIC IRON; A. M. MacFarland, Wilkinsburg, Pa. App. filed March 23, 1922.

1,533,264. ELECTRIC FURNACE RESISTOR; T. A. Reid, Pittsburgh, Pa. App. filed Dec. 17, 1921.

1,533,265. ELECTRIC CRUCIBLE FURNACE; T. A. Reid, Wilkinsburg, Pa. App. filed Jan. 7, 1922.

1,533,266. DOUBLE CHAMBER ANNEALING FURNACE; T. A. Reid, Wilkinsburg, Pa. App. filed Feb. 6, 1922.

1,533,267. TEMPERATURE INDICATOR AND CONTROLLER; T. A. Reid, Pittsburgh, Pa. App. filed April 18, 1922.

1,533,268. ELECTRIC STEAM BOILER; T. A. Reid, Pittsburgh, Pa. App. filed Sept. 2, 1922.

1,533,269. ELECTRIC FURNACE; T. A. Reid, Pittsburgh, Pa. App. filed Nov. 1, 1922. Resistance type.

1,533,270. FURNACE TERMINAL; T. A. Reid, Wilkinsburg, Pa. App. filed Nov. 7, 1922.

1,533,277. MEANS FOR PREVENTING ARMATURE-COIL HEATING; J. Slepian, Wilkinsburg, Pa. App. filed Aug. 15, 1919. In single-phase commutator motors for railway purposes.

1,533,278. PLATE-CIRCUIT EXCITATION; J. Slepian, Swissvale, Pa. App. filed Nov. 20, 1920. For vacuum tubes.

1,533,279. ELECTRICAL CONNECTION FOR RAILWAY RAILS; J. D. Sturgeon, Guthrie, Okla. App. filed Oct. 31, 1922.

1,533,282. PROTECTIVE SYSTEM FOR HEATING DEVICES; F. Thornton, Jr., Wilkinsburg, Pa. App. filed June 16, 1922.

1,533,283. AUTOMATIC THERMAL CONTROL SYSTEM; F. Thornton, Jr., Wilkinsburg, Pa. App. filed Dec. 13, 1922.

1,533,288. ELECTRIC MUFFLE FURNACE; J. C. Woodson, Mansfield, Ohio. App. filed Oct. 2, 1922.

1,533,289. STREET-CAR HEATER; J. C. Woodson, Mansfield, Ohio. App. filed Oct. 4, 1922.

1,533,290. ELECTRIC CANDY-WARMING TABLE; J. C. Woodson, East Pittsburgh, Pa. App. filed Dec. 2, 1922.

1,533,291. STERILIZER HEATER; J. C. Woodson, East Pittsburgh, Pa. App. filed Dec. 2, 1922.

1,533,293. ELECTRIC HEATING UNIT; J. C. Woodson, East Pittsburgh, Pa. App. filed March 13, 1924. For electric furnaces.

1,533,310. INTERLOCK DEVICE; C. C. Farmer Pittsburgh, Pa. App. filed Sept. 13, 1922. Used in connection with a switch for controlling electric train line circuits.

1,533,311. SECRET SIGNALING; H. Fletcher, New York, N. Y. App. filed Dec. 18, 1923. Wave transmission.

1,533,319. AUTOMATIC ADJUSTING MECHANISM FOR SYNCHRONOUS APPARATUS; O. E. Kellum, Los Angeles, Cal. App. filed Nov. 20, 1920. As in the use of a phonograph and kinetograph.

1,533,356. ELECTRICAL MEASURING INSTRUMENT; V. H. Wood, Rainbow Lake, N. Y. App. filed May 3, 1919. Volt-ampere meters.

1,533,370. SWITCH MECHANISM; H. L. Blood, Plainfield, N. J. App. filed Jan. 31, 1920. For controlling the operation of electric motors.

1,533,376. AUTOMATIC TELEPHONE SWITCH; F. J. Brownell, Queens, N. Y. App. filed May 11, 1922.

1,533,394. FIRE-ALARM APPARATUS; M. Costello, Jersey City, N. J. App. filed Nov. 21, 1923.

1,533,412. CORD HOLDER FOR SADIRONS; G. A. Herron, Ottawa, Ontario, Canada. App. filed Feb. 13, 1925.

Financial and Corporate

Utility Market Rallies

National Power & Light and Southeastern Power & Light Lead Advance

THE market in public utility stocks has run into a period of strength that resembles to a degree the strong markets of a year ago. Not in any week of the year to date have these stocks shown as much real strength marketwise as during the past week. A return of better buying for listed stocks generally has helped to turn the attention of the market again to the utilities, but gains in the power and light group have been even more impressive than those of other groups.

National Power & Light has made the most spectacular advance of any stock recently, the price last week having gone up forty-two points to a new high record. Reports persist that this stock will be split into smaller units, but nothing in the nature of a confirmation has been officially announced. Persons close to the company say that undoubtedly a division of the shares will take place eventually but that the matter is not now one that is before the board. Southeastern Power & Light in selling above 76 also established a new high price for all time and added thirteen points to its position of the week before. This company has added numerous new properties to its list and is in position to show good earnings this year.

Carolina Power & Light improved its position by eighteen points, and numerous power and light stocks advanced in the neighborhood of five, six or seven points. In the latter group may be mentioned such stocks as American Gas & Electric, American Power & Light, Continental Gas, Electric Bond & Share, Lehigh Power Securities, Middle West Utilities, Northern Texas Electric and United Gas & Electric.

Among the low-priced stocks considerable attention has been given of late to Northern Ohio Power, which last week broke new high ground above 8. On the Stock Exchange a good market has developed for such leaders as American Water Works & Electric and North American Company.

New Capital Issues

The Cities Service Company during the past week floated a ten-million-dollar issue of 6 per cent refunding gold debenture bonds at 91 and interest, to yield 6.65 per cent. The proceeds of these bonds, dated May 1, 1925, and maturing January 1, 1966, are to be applied to retiring convertible debentures of the company and funded debts of subsidiary companies issued and outstanding on January 1, 1925.

Twenty-year first and refunding mortgage gold bonds, series B, 6 per cent, were offered by the Savannah Electric & Power Company to the amount of $1,200,000. The proceeds of this issue will be used to retire $1,000,000 6½ per cent coupon notes of the company maturing July 1, 1925, and to retire other floating debts incurred for additions and improvements.

The Central Illinois Public Service Company offered 7,000 shares of cumulative preferred stock at $88 a share and accrued dividend to yield over 6.80.

The first public offering of securities of the American Superpower Corporation was made during the week, consisting of 35,000 shares of the company's first preferred stock at no par value. The stock was priced at $95 a share and accrued dividends to yield over 6.30 per cent. The proceeds will be used for the acquisition of additional interests in light and power properties.

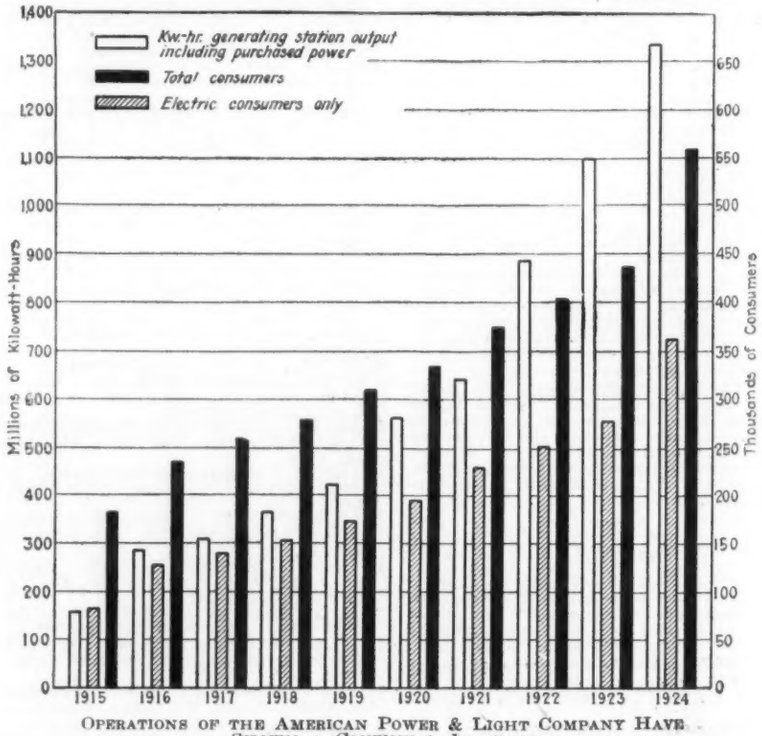
Electric Bond & Share's Star Utility

American Power & Light Company's 1924 Annual Report, Just Published, Adds a Fresh Chapter to a Record Already Distinctive

BY PAUL WILLARD GARRETT

THE American Power & Light Company, the principal holding company among those that enjoy the expert supervision in all matters of the Electric Bond & Share Company, this week issued its 1924 annual report. The report adds to those that have gone before it another chapter of growth so unusual as to make the company's performance of peculiar interest to the industry in general.

Gross earnings of American Power & Light subsidiary companies in 1924 reached a new record high figure of $42,078,837, which clearly gives the utility rank as one of the largest of its kind in the world. Similar earnings for 1923 had been only $31,799,862. To the present substantial position in gross earnings American Power & Light has risen by steady yearly gains since 1909, the year of organization, when gross earnings totaled only $1,599,732. Gross earnings have now passed the forty-million-dollar mark by a good margin, but they had not reached the ten-million-dollar mark until 1917, the twenty-million-dollar mark until 1920 or the thirty-million-dollar mark until 1923. Perhaps no other large power and light organization in the world has had a more steady growth year after year and month after month than the American Power & Light Company. In every calendar year since organization gross earnings have shown an increase over those of the preceding calendar year, but that is not all. For its full fifteen years of existence gross earnings for each successive twelve-month



OPERATIONS OF THE AMERICAN POWER & LIGHT COMPANY HAVE SHOWN A CONTINUAL INCREASE

period have been larger than earnings for the corresponding twelve-month period of the year before. The company has never yet suffered an interruption in its own growth. The increase in such earnings for the twelve months ended December 31, 1924, over those of the year before was no less than 32 per cent.

The same sort of remarkable growth may be claimed for net earnings. Growth has been continuous from the date of organization, the total net figure having increased from $563,437 in 1909 to $17,562,926 in 1924. Net for last year, indeed, jumped relatively more than gross over the year before, or 36 per cent for net as compared with 32 per cent for gross.

No electric power and light holding company in the world has worked out such an unusual degree of diversification in the territory that it serves, and herein, incidentally, lies partial explanation for the consistency of the growth. When earnings decline in one section they have always been more than offset by gains elsewhere. American Power & Light operating subsidiaries at the end of 1924 served a total of 486 communities in eleven States, namely, Arizona, Florida, Idaho, Iowa, Kansas, Minnesota, Nebraska, Oregon, Texas, Washington and Wisconsin. In the year under review American Power & Light added two important groups of properties, one in Florida and one in Arizona, illustrating afresh the principle of diversification in the selection of properties. There now are eight important utilities of which American Power & Light owns virtually all of the common stock (and in some cases various amounts of preferred and second preferred stocks as well as certain indebtedness) as follows: (1) Kansas Gas & Electric Company, (2) Pacific Power & Light Company, (3) Portland Gas & Coke Company, (4) Nebraska Power Company, (5) Minnesota Power & Light Company, (6) Florida Power & Light Company (including also associated companies), (7) Central Arizona Light & Power Company, and (8) Southwestern Power & Light Company. In addition, it now controls the Northwestern Electric Company, operating in Portland, Ore., and vicinity, but as the control of this company was not acquired until the present calendar year, none of the earnings or statistics on its property appear in the annual report for 1924. Seventy-two per cent of American Power & Light subsidiary revenues last year was derived from electric power and light activities, sixteen from manufactured gas and only 1 per cent from railway activities.

While the American Power & Light Company for years has been working along sound lines to build up real assets behind its securities, the general public apparently has not come to appreciate the value of the common stock until a relatively recent period. This stock now sells in the open market around $60 a share, which is the equivalent of $600 for the old shares. These a little more than a year ago could have been had for $200 a share. Earnings for 1924, after all charges and preferred dividends and after appropriations of $2,701,616 to renewal and replacement (depreciation) reserves by subsidiaries, applicable to the 1,565,023 no-par shares of common stock outstanding at the close of the year were at the rate of $3.39 per share, as against the equivalent of $2.41 in 1923. Excellent management for the properties that make up the system, sound financing and assured growth for the future are what make the shares popular with investors rather than the opportunity for large cash returns immediately on an investment in the stock. As the company pays its dividends on common stock partly in cash and partly in common stock, the holders have a continuing share in the company's expansion.

Annual Reports of Electric Light and Power Companies

The consolidated income statement of the North American Company, whose subsidiaries serve Cleveland, Milwaukee and St. Louis and surrounding territory with electric light and power, for the twelve months ended March 31, 1925, shows gross earnings of $81,930,010, an increase of $4,552,931, or 5.88 per cent, and a net income of $33,008,927, an increase of $3,994,487, or 13.77 per cent. The electric output for the twelve months amounted to 2,410,057,859 kw.-hr., an increase of 191,866,723 kw.-hr., or 8.65 per cent. During the same period 45,802 customers were added, 654,842 being served on March 31, 1925.

The Los Angeles Gas & Electric Corporation in its annual report and year book for 1924 reports gross earnings amounting to $16,056,722 and operating expenses, including taxes, totaling $9,446,604, leaving a net operating income of $6,610,118. The output of electrical energy in kilowatt-hours showed an increase of 24.96 per cent over the preceding year—158,805,776 (exclusive of energy supplied to relieve the shortage on other systems) as compared with 127,357,201 in 1923. The number of meters increased from 358,274 in 1923 to 417,393 in 1924.

The Western United Gas & Electric Company for the fiscal year ended January 31, 1925, reports total income from all departments of $3,992,185 and total expenses amounting to $2,770,359. Electric meters in use numbered 14,427 against 13,300 for the previous year, an increase of 1,127. There were 16,704,102 kw.-hr. sold to customers as compared with 14,736,778 kw.-hr. the preceding year and 18,775,560 kw.-hr. sold to other utilities against 2,024,930 kw.-hr.

The Pacific Lighting Corporation reports for the year 1924 gross income amounting to $16,204,334, an increase over 1923 of $3,354,702, or 26.2 per cent. These figures include the gross operating revenue of the Los Angeles Gas & Electric Corporation. This organization's electric sales in 1924 increased 23.1 per cent over those of 1923, exclusive of the sales made to the Southern California Edison Company during the drought period. A net gain of 21,432 electric meters was made during the year, bringing the total number set on December 31, 1924, up to 417,393. Deducting operating expenses, taxes, interest, depreciation, preferred dividends paid by the Los Angeles company and other items, the Pacific Lighting Corporation reported a net profit of $2,636,594.

The Hartford Electric Light Company for 1924 reports total sales of electrical energy amounting to $4,724,400, as compared with $4,718,000 in 1923, and expenses, exclusive of taxes, totaling $2,267,700, against $2,522,600 during the preceding year. The output dropped from 181,000,000 kw.-hr. in 1923 to 163,000,000 kw.hr. in 1924, but compares favorably with the 1922 figure of 134,000,000 kw.-hr.

The Montreal Light, Heat & Power Consolidated reports gross revenue for the fiscal year ended December 31, 1924, amounting to $17,394,092 and operating expenses, taxes and depreciation and renewal reserve totaling $9,723,902, leaving a net revenue of $7,670,190. The surplus earnings as well as the gross and net revenues show substantial increases over the previous year, notwithstanding the industrial depression that prevailed during the period and the liberal reduction made in rates for service in the early part of the year. Considerable additions and extensions were made to the generation and distribution systems, representing a sum of $3,251,667.

Company Reports

The following reports were issued recently by electric light and power companies for the month of March:

Name of Company	Gross Earnings for March 1925	1924
Bangor Hydro Electric	$136,286	$138,853
Commonwealth Power	2,772,421	2,803,760
Consumers' Power	1,656,223	1,601,032
Great Western Power	637,816	627,828
Kansas City Power & Light	834,198	822,344
Northern Ohio Power	941,924	867,897
Portland Electric Power	943,847	951,875
Public Service Corp. of N. J.	7,690,862	7,305,449
Republic Railway & Light	949,170	938,309
Staten Island Edison and affiliated companies	233,107	220,584
Tennessee Electric Power	907,561	796,296
United Gas & Electric	1,201,719	1,181,477
Virginia Railway & Power	874,722	885,437

Dividends Declared

The quarterly dividends listed in the following table were announced recently by electric light and power companies:

Name of Company	Per Cent	When Payable
Cedar Rapids Mfg. & Power	1½	May 15
Consolidated Utilities, pf	1¾	May 1
Eastern Shore Gas & Elec., pf.	2	June 1
Kaministiquia Power	2	May 15
Middle West Utilities	$1.25	May 15
Montreal Light, Heat & Power, com.	2	May 15
Pacific Lighting, com	2½	May 15
Pacific Lighting, pf	1¾	May 15

Hodenpyl-Hardy Form New Corporation. — Announcement has just been made by Hodenpyl, Hardy & Company, Inc., a prominent public utility management and banking house, of the organization of the Hodenpyl-Hardy Securities Corporation to engage in the purchase and sale of investment securities. The new corporation will take over the business of the bond department of the parent company and will provide greatly enlarged facilities for underwriting and distributing securities. Offices will be maintained at 14 Wall Street, New York, and 231 South La Salle Street, Chicago. The officers are: President, George E. Hardy; vice-presidents, Hardy M. Tingle, James McMillen and Fred W. Hoover; secretary and treasurer, Anton G. Hardy.

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stocks is $100.)

Companies	Bid Price Saturday, May 2	Low 1925	High 1925
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	100	98	102
Appalachian Power, 7 per cent	97½	92	100
Arkansas Light & Power 7 per cent	93½	92	98
Asheville Power & Light 7 per cent	*a* 99	99	100
Central Illinois Public Service 6 per cent	90	84	93
Colorado Power 7 per cent	94	93	98
Connecticut Light & Power 7 per cent	106	105	110
Consumers' Power 6 per cent	91½	90	93½
Dayton Power & Light 6 per cent	92	88	100
Duquesne Light 7 per cent	*a*107½	105	107½
Eastern Texas Electric 6 per cent	100	100	105
Empire District Electric 6 per cent	78	78	85
Fort Worth Power & Light 7 per cent	*a*101	100	102
Great Western Power 7 per cent	98		
Illinois Northern Utilities 6 per cent	88	82	92
Illinois Power & Light 7 per cent	94	92½	98
Kansas Gas & Electric 7 per cent	*a* 99½	99½	100
Long Island Lighting 7 per cent	101	100	105
Minnesota Power & Light 7 per cent	*a* 98½	98½	99½
Mississippi River Power 6 per cent	90	87½	92
Nebraska Power 7 per cent	*a*100	100	101
Niagara Falls Power 7 per cent—25	28½	28	29
Niagara, Lockport & Ont. Power 7 per cent	105½	101½	110
Northern States Power 7 per cent	96	95	100
Ohio Public Service 7 per cent	97	97	100
Pacific Gas & Electric 6 per cent	95	92	97
Pacific Power & Light 7 per cent	*a* 99	99	100
Penn-Ohio Power & Light 7 per cent	94	91	100
Pennsylvania Power & Light $7—no par	*a*101	100½	101½
Penn. Public Service 7 per cent	90	90	100
‡Philadelphia Electric 8 per cent—25	37½	37½	37½
Southern California Edison 8 per cent	118	115	122
Tennessee Electric Power, 6 per cent	81	80	84
Texas Power & Light 7 per cent	*a*100	100	101
Utah Power & Light 7 per cent	*a* 99½	99½	100½
Western States Gas & Electric 7 per cent	89	82	89
Yadkin River Power, 7 per cent	*a* 99	99	99
Holding Companies			
American Gas & Electric 6 per cent—no par	85½	85	89
American Light & Traction	95½	93	97
American Power & Light 6 per cent	87	84	90
American Public Service 7 per cent	91	88	94
American Public Utilities 7 per cent	88	87	95
American Water Works & Electric 7 per cent	*a*101½	95½	103½
Associated Gas & Electric 7 per cent—1 per cent extra—no par	*a* 52		
Carolina Power & Light 7 per cent	103	100	105
Central Indiana Power 7 per cent	89	88	95
Cities Service 6 per cent	81	80	83
Commonwealth Power 6 per cent	81	80	82½
Consolidated Gas 6 per cent—50	58½	57½	59
Continental Gas & Electric 7 per cent pr. pf.	90	89	95
Electric Bond & Share 6 per cent	103	102	104
General Gas & Electric—$8—no par	109	104½	111
*Middle West Utilities 7 per cent	97	91½	98½
National Power & Light—$7—no par	97	95	99
North American 6 per cent—50	*a* 48½	46½	49
Public Service Corp. of N. J. 7 per cent	*a*100½	99	102
Public Service Corp. of N. J. 8 per cent	*a*110½	108½	112½
Standard Gas & Electric 8 per cent—50	*a* 52½	50½	53½
†United Gas Improvement—50	57½	56½	58½
United Light & Power—$6.50—no par	81	81	88
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	57	31	62
Appalachian Power—no par	77	70	83
Arkansas Light & Power	75	65	85
Brooklyn Edison	*a*130	120½	133
Buffalo General Electric—no par (new)	51	44	51½
*Commonwealth Edison	*a*130½	130½	139
§Consolidated Gas, Electric Light & Power	35	32	35¼
Dayton Power & Light	420	180	460
Detroit Edison	*a*115½	110	119
|| Edison Electric Illuminating of Boston	201	163½	204½
Long Island Lighting (new)	80	60	85
Mississippi River Power	40	37	42
Montana Power	*a* 73½	64	73½
Niagara Falls Power—no par	57	45½	58
Niagara, Lockport & Ontario Power—no par	60	60	73
Northern Ohio Power	7	5	7½
Northern States Power	108	103	110
North Texas Electric	60	60	70
Pacific Gas & Electric	*a*105	102½	108½
‡Penn Central Light & Power—no par	63	60	64½
§Pennsylvania Water & Power	129½	126½	133
‡Philadelphia Electric—25	38½	37½	45½
Public Service Co. of Northern Illinois	114	97	116
Puget Sound Power & Light	49	49	58
Southern California Edison	107	102	107½
Tennessee Electric Power—no par	59	47	61
Virginia Power	65	65	92
Virginia Railway & Power	111½	64½	113½
West Penn. Co.	112½	105	120

Companies	Bid Price Saturday, May 2	Low 1925	High 1925
Holding Companies			
American Gas & Electric—no par	78	70	80
American Light & Traction	152	139	153
American Power & Light	56½	52	67
American Public Utilities	74	70	85
American Water Works & Electric	*a* 50½	34½	53½
Associated Gas & Electric, Class A	28½		
Carolina Power & Light—no par	335	290	350
Cities Service (new)	37	34	43
Columbia Gas & Electric—no par	*a* 61½	45½	62½
Commonwealth Power Corp.—no par	117	106	126
Consolidated Gas—no par	*a* 83	74½	83½
Continental Gas & Electric	81	77	90
Electric Power & Light	*a* 24½	17½	24½
Federal Light and Traction	*a*155	114½	155½
General Gas & Electric	78	72	82
Lehigh Power Securities—no par	104	82	116
*Middle West Utilities—no par	88	82½	102½
National Power & Light—no par	262	185	270
North American—10	*a* 48½	41½	49½
Philadelphia Co.—50	*a* 55½	51½	57½
Power Securities—no par	10		
Public Service Corp. of N. J.—no par	*a* 68	62½	72½
Standard Gas & Electric—no par	*a* 46½	40½	47½
United Gas & Electric (Conn.)—no par	28½	26	37½
Utah Securities	88	41½	88
BONDS			
Operating Companies			
Adirondack Power & Light 6s	1950	104½	102½ 105
Alabama Power 5s	1946	98½	96 99
Appalachian Power 5s	1941	98½	96 99
Brooklyn Edison 5s	1949	101½	99½ 101½
6s	1930	105	104 105½
Cleveland Electric Illuminating 5s	1939	100½	100 101½
Commonwealth Edison 5s	1943	100½	99½ 101
5s	1953	99½	98 99½
§Consol. Gas, Elec. Lt. & Pwr. 4½s	1935	96½	93½ 97½
6s	1949	107½	104½ 107½
Consumers' Power 5s	1936	99½	99 99½
5s	1952	95½	90½ 95½
Detroit Edison 5s	1933	101	99½ 102½
Duquesne Light 6s	1949	105½	104½ 107
Great Western Power 5s	1946	97½	95 98½
Kansas City Power & Light 5s	1952	98½	95½ 98½
Mississippi River Power 5s	1951	98½	96½ 99
Montana Power 5s	1943	100½	97½ 100½
New England Power 5s	1951	101½	100½ 102
New York Edison 6½s	1941	113½	112 115
Niagara Falls Power 6s	1932	105½	103½ 105½
Northern States Power 5s	1941	96½	93 97
6s	1941	104½	103 107½
Ohio Power 7s	1951	106½	106½ 107½
Pacific Gas & Electric 5s	1942	97	93½ 97½
Pennsylvania Water & Power 5s	1940	100½	100 100½
‡Philadelphia Electric 5s	1966	101½	100½ 102
5½s	1947	104½	103½ 105½
6s	1941	107½	106 107½
Portland Electric Power 6s	1947	97	96½ 97½
Southern California Edison 5s	1939	99½	99½ 100½
6s	1944	103½	102½ 104½
Tennessee Electric Power 6s	1947	101	99½ 102½
Texas Power & Light 5s	1937	97½	97 98
Toledo Edison 7s	1941	109½	108½ 110½
Utah Power & Light 5s	1944	95½	91 95½
Holding Companies			
Alabama Traction, Light & Power 5s	1962	88½	86 90
American Gas & Electric 6s	2014	96½	96½ 97
American Power & Light 6s	2016	95	94 95½
Amer. Water Works & Electric 5s	1934	95½	92½ 96½
Associated Gas & Electric 6½s	1954	*a*102	
Central Indiana Power 6s	1947	98	95½ 98½
Commonwealth Power 6s	1947	100½	97½ 101½
Consolidated Cities Lt., Pwr. & Tr. 5s	1962	79	75½ 80½
Illinois Power & Light 6s	1953	100½	100½ 102
United Light & Railways 5s	1932	95½	93½ 96½
6s	1952	98	95½ 99½
ELECTRICAL MANUFACTURING COMPANIES			
PREFERRED STOCKS			
Allis-Chalmers Manufacturing		103½	90 104½
*National Carbon		124	120 124
Worthington Pump & Machinery A		79	68 89½
COMMON STOCKS			
Allis-Chalmers Manufacturing		*a* 79½	71½ 86½
American Bosch Magneto—no par		*a* 29½	26½ 54½
Electric Storage Battery—no par		*a* 63	60½ 70½
General Electric		*a*273	227½ 320
General Electric—10		*a* 11½	11 11½
*Hurley Machine—no par		44½	41½ 56
†Wagner Electric		35	26½ 50
Westinghouse Electric & Manufacturing—50		*a* 68½	66½ 84
Worthington Pump & Machinery		*a* 46	42½ 79½
BONDS			
General Electric 3½s	1942	83½	83 84
5s	1952	105	101½ 105½
Robbins & Myers 7s	1952	65	65 73½
Western Electric 5s	1944	100½	98 100½
Westinghouse Electric & Mfg. 7s	1931	107½	107½ 108½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. || Boston Stock Exchange § Baltimore Stock Exchange.
a Bid price, low and high, Tuesday, May 5.